
CAIRNHILL METROLOGY PTE LTD

5 Jalan Kilang Barat #07-05/06 Petro Centre
Singapore 159349

Tel: +65 68900041
Fax: +65 65675940

**CAIRNHILL METROLOGY
(THAI) LTD**

89 Cosmo Office Park, 7th Floor Unit N
Popular Road, Ban Mai, Pakkret
Nonthaburi 11120, Thailand

Tel: +66 2 1160501
Fax: +66 2 1160503

89 Cosmo Office Park, 1st Floor Unit 6
Popular Road, Ban Mai, Pakkret
Nonthaburi 11120, Thailand

PT CAIRNHILL SERVICHE INTI

Delta Commercial Park, Jl. Kenari Jaya
Blok B5-B6, Jayamukti, Cikarang Pusat
Kab. Bekasi, Jawa Barat 17815, Indonesia

Tel: +62 21 89909127
Fax: +62 21 8973263

With engineers stationed also at Surabaya,
Medan, Semarang, Makassar and Batam

CAIRNHILL METROLOGY SDN BHD

18 Jalan Serendah 26/41, Sekitar 26
Seksyen 26, 40400 Shah Alam
Selangor Darul Ehsan, Malaysia

Tel: +60 3 51911200
Fax: +60 3 51036873

10-G Persiaran Bayan Indah
Bayan Bay, Sungai Nibong
11900 Penang, Malaysia

Tel: +60 4 6446964
Fax: +60 4 6447586

19 Jalan Ekoperniagaan 2/8
Taman Ekoperniagaan
81100 Johor Bahru, Johor, Malaysia

Tel: +60 7 5627066
Fax: +60 7 5625066

**CAIRNHILL METROLOGY
(PHILS) INC**

Units 7-10 8F, Paz Madrigal Plaza
Lot-1 Finance St, Corner Industry St
Madrigal Business Park
Ayala Alabang, Muntinlupa City 1780
Philippines

Tel: +63 2 88428116

Unit 509 IMEZ Bldg, Pueblo Verde
Mactan Economic Zone II
Lapu-Lapu City, Mactan
Cebu, 6015 Philippines

Tel: +63 32 5135963 (Wireless)
Fax: +63 32 5203196 (Office)



CAIRNHILL METROLOGY

CAIRNHILL METROLOGY 2022

Portable Metrology Solutions
Quality Assurance Anywhere!



www.cairnhill.com

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Cairnhill Metrology is an industrial metrology solutions provider established on 16 August 1983. Working with a long-term view, we partner with principals who are global leaders in their fields, whose strengths in technology and innovation, we complement with up-to-date uniform high standards of service delivery through our network of offices in Singapore, Malaysia, Indonesia, the Philippines and Thailand.

Our **Vision** is to be our customers' trusted industrial metrology solutions provider of choice in the region.

Our **Mission** is to support our customers' quests for production efficiencies and quality via appropriate and reliable metrology solutions, supported throughout the solutions useful life.

Our **Values** are summed up in the Golden rule, "What you wish that others do to you, do so to them".

Our Solutions are focussed by groups: -

- **Food, Pharmaceutical Industrial Solutions (FPIS)**
- **Portable Metrology (PMT)**
- **Industrial Metrology (IMT)**
- **Industrial X-Ray Computed Tomography (XCT)**
- **Software for Visualization, Analysis, Metrology, Process Control and Reverse Engineering**

Portable Metrology

In dimensional metrology, portability and freedom, usually means increased error. The more rigid or the lesser the degree of freedoms, the more accurate a system is. Today's increasing need for quality and product safety however means that checks must to be deployed earlier, right at production if possible, and include the measuring of large parts and hard-to-access features. If only metrology systems can be **flexible** and **portable** and yet still **accurate**, they could be used on shop floors, aircraft hangars, refineries, etc.

Thankfully, exciting innovations and advances in optics, electronics and software have provided just these features, allowing portable metrology to be deployed in production and quality environments everywhere.

Quality Assurance Anywhere!

Today's portable metrology enable measurements anywhere for immediate productivity improvements. If your part is too big to bring to your CMM, bring your CMM to the part!

Check out our comprehensive range of Portable Arm CMMs, 3D Digitizers and Optical/Laser Trackers with touch probes, laser scanners and optical reflectors, which can be automated or robotized, as well as real-time high-density point cloud software for efficient metrology inspections and reverse engineering.

Fast installation, simple operations, improved reliability plus Cairnhill Metrology services near you!

Call us for a demonstration, applications support or calibration anytime!

Portable Metrology Now: At-site, on-site, in airfields, shipyards, refineries... Anywhere!

Portable Metrology

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Hexagon Absolute Arm **World's First IP54-Protected PCMM** *NEW!*

For Portable 3D Scanning and Probing Anywhere!

PATENTED! Exclusive Absolute Encoders within every articulated joint make the Absolute Arm the only portable measuring arm that has completely eliminated warm-up times and encoder referencing before use.

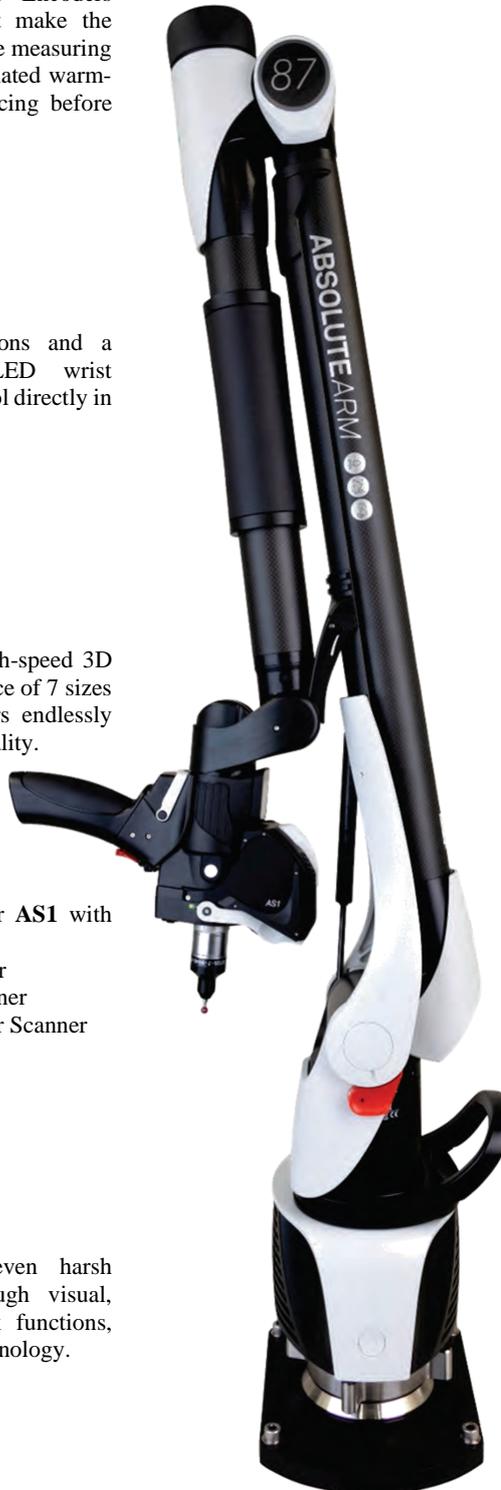
Multi-functional control buttons and a convenient touchscreen OLED wrist display put measurement control directly in the user's hand.

Wide range of probes and high-speed 3D scanners combined with a choice of 7 sizes and 3 accuracy levels delivers endlessly flexible measurement functionality.

Laser Scanners

- Flagship Absolute Scanner **AS1** with IP54 protection
- Reliable **RS5** Laser Scanner
- **RS-SQUARED** Area Scanner
- Entry-level **HP-L-8.9** Laser Scanner

Easy user interaction in even harsh industrial environments through visual, acoustic and haptic feedback functions, augmented with Bluetooth technology.



Unique Zero-G Counter-Balance system and low-friction rotating grips reduce user fatigue and maximise accuracy by minimising inertia.

Unique modular wrist designed to make measurements flexible, fast and secure. Pistol grips in three sizes; and completely removable to measure hard-to-reach holes and cavities. Laser scanners are also removable, and quickly replaced later with no recalibration needed, for measurements in tight areas.

High-quality construction and sealing have allowed the Absolute Arm to be the world's first IP54-rated portable arm, as well as allowing for operation in environmental temperatures of up to 45°C.

High-tech carbon-fibre tube construction ensures strength and thermal stability under any environmental conditions.

The HomeDock and SmartLock features allow the arm to be stowed and locked in place between measurements, for greater security during transport, set-up and station changes.

True wireless connectivity and hot-swappable batteries give greater flexibility when moving the arm around the shop floor, along with full -speed WiFi scanning performance.

Hexagon Absolute Arm All Models @ a Glance!

Measuring Range	1.2m	2.0m	2.5m	3.0m	3.5m	4.0m	4.5m
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Hexagon Absolute Arm 7-Axis Series

		1.2m	2.0m	2.5m	3.0m	3.5m	4.0m	4.5m	
87 Series	EUNI ¹	N/A		0.029mm	0.053mm	0.064mm	0.078mm	0.104mm	
	P _{SIZE} ²			0.011mm	0.018mm	0.022mm	0.028mm	0.044mm	
	L _{DIA} ³			0.044mm	0.076mm	0.092mm	0.110mm	0.125mm	
	P _{FORM} ⁴			0.023mm	0.035mm	0.041mm	0.046mm	0.060mm	
	AS1 SSA ⁵			0.043mm	0.056mm	0.068mm	0.080mm	0.121mm	
	RS5 SSA ⁵			0.044mm	0.058mm	0.071mm	0.082mm	0.127mm	
	RS-SQUARED SSA ⁵			0.123mm	0.148mm	0.173mm	0.198mm	0.222mm	
	Weight ⁶			9.3kg	9.6kg	9.9kg	10.2kg	10.5kg	
	Max Reach			2.98m	3.48m	3.98m	4.48m	4.98m	
85 Series	EUNI ¹	N/A		0.029mm	0.031mm	0.057mm	0.069mm	0.113mm	
	P _{SIZE} ²			0.010mm	0.012mm	0.020mm	0.024mm	0.030mm	0.048mm
	L _{DIA} ³			0.038mm	0.048mm	0.083mm	0.099mm	0.120mm	0.140mm
	P _{FORM} ⁴			0.021mm	0.025mm	0.038mm	0.045mm	0.050mm	0.065mm
	AS1 SSA ⁵			0.041mm	0.047mm	0.064mm	0.078mm	0.089mm	0.141mm
	RS5 SSA ⁵			0.045mm	0.048mm	0.066mm	0.080mm	0.091mm	0.148mm
	RS-SQUARED SSA ⁵			NA	0.138mm	0.168mm	0.196mm	0.228mm	0.271mm
	Weight ⁶			9.0kg	9.3kg	9.6kg	9.9kg	10.2kg	10.5kg
	Max Reach			2.48m	2.98m	3.48m	3.98m	4.48m	4.98m
83 Series	EUNI ¹	N/A		0.043mm	0.048mm	0.078mm	0.092mm	0.158mm	
	P _{SIZE} ²			0.016mm	0.023mm	0.034mm	0.042mm	0.051mm	0.078mm
	L _{DIA} ³			0.054mm	0.060mm	0.090mm	0.115mm	0.140mm	0.168mm
	P _{FORM} ⁴			0.033mm	0.043mm	0.058mm	0.067mm	0.084mm	0.106mm
	AS1 SSA ⁵			0.059mm	0.065mm	0.082mm	0.099mm	0.118mm	0.163mm
	RS5 SSA ⁵			0.062mm	0.068mm	0.092mm	0.105mm	0.122mm	0.172mm
	RS-SQUARED SSA ⁵			NA	0.164mm	0.204mm	0.242mm	0.283mm	0.338mm
	Weight ⁶			8.8kg	9.1kg	9.4kg	9.7kg	10.0kg	10.3kg
	Max Reach			2.48m	2.98m	3.48m	3.98m	4.48m	4.98m

Hexagon Absolute Arm 6-Axis Series

		1.2m	2.0m	2.5m	3.0m	3.5m	4.0m	4.5m
87 Series	EUNI ¹	N/A		0.026mm	0.039mm	0.052mm	0.063mm	0.074mm
	P _{SIZE} ²			0.009mm	0.014mm	0.018mm	0.022mm	0.026mm
	L _{DIA} ³			0.032mm	0.048mm	0.064mm	0.079mm	0.094mm
	P _{FORM} ⁴			0.018mm	0.028mm	0.037mm	0.041mm	0.046mm
	Weight			8.3kg	8.6kg	8.9kg	9.2kg	9.5kg
	Max Reach			2.73m	3.23m	3.73m	4.23m	4.73m
85 Series	EUNI ¹	0.019mm	0.023mm	0.028mm	0.042mm	0.055mm	0.067mm	0.080mm
	P _{SIZE} ²	0.006mm	0.008mm	0.010mm	0.015mm	0.020mm	0.024mm	0.028mm
	L _{DIA} ³	0.016mm	0.030mm	0.035mm	0.053mm	0.069mm	0.085mm	0.102mm
	P _{FORM} ⁴	0.012mm	0.017mm	0.020mm	0.030mm	0.040mm	0.045mm	0.050mm
	Weight	12.2kg	8.0kg	8.3kg	8.6kg	8.9kg	9.2kg	9.5kg
	Max Reach	1.49m	2.23m	2.73m	3.23m	3.73m	4.23m	4.73m
83 Series	EUNI ¹	0.024mm	0.040mm	0.046mm	0.067mm	0.085mm	0.100mm	0.120mm
	P _{SIZE} ²	0.010mm	0.013mm	0.020mm	0.029mm	0.038mm	0.046mm	0.052mm
	L _{DIA} ³	0.021mm	0.042mm	0.053mm	0.071mm	0.090mm	0.105mm	0.110mm
	P _{FORM} ⁴	0.018mm	0.026mm	0.038mm	0.054mm	0.063mm	0.077mm	0.086mm
	Weight	12.0kg	7.8kg	8.1kg	8.4kg	8.7kg	9.0kg	9.3kg
	Max Reach	1.49m	2.23m	2.73m	3.23m	3.73m	4.23m	4.73m

Hexagon Absolute Arm Compact 10360-2

8312		MPE _p ⁷ : 0.008mm	MPE _e ⁸ : 5+L/40 < 0.018mm
8512		MPE _p ⁷ : 0.006mm	MPE _e ⁸ : 5+L/65 < 0.015mm

Hexagon Absolute Arm All Models @ a Glance!

Hexagon Absolute Arm Technical Specifications	
Operating Temperature	+5° to +45°C
Storage Temperature	-30° to +70°C
Operational Elevation	Up to 2000m
Relative Humidity	10–90% non-condensing
Protection Rating	IP54
Marks of Conformity	CE – FCC – IC
Power Requirement	110–240V



AS1



RS5



RS-SQUARED



HP-L-8.9

	AS1	RS5	RS-SQUARED	HP-L-8.9
Scanner Type	Blue Laser Line	Red Laser Line	Structured Light	Red Laser Line
Accuracy	0.016mm ⁹	0.028mm (2σ)	0.06mm (2σ)	0.04mm (2σ)
Point Acquisition Rate	Max 1.2 million pts/s	752,000 pts/s	4million pts/s *	45,000 pts/s
Points per Line	Max 4000	Max 7520	1 million	750
Line Rate	Max 300Hz	Max 100Hz	Max 4Hz	60Hz
Line Width (mid)	150mm	115mm	-	80mm
Frame Size (mid-range)	-	-	300x300mm	-
Standoff	165±50mm	165±50mm	300±50mm	135±45mm
Minimum Point Spacing	0.027mm	0.011mm	0.21mm	0.08mm
System Scanning Certification	Yes	Yes	Yes	No
Laser Class	2	2M	2	2
Protection Rating	IP54	-	-	-
Operating Temperature	5–45°C	5–40°C	5–45°C	5–40°C
Weight	0.4kg	0.4kg	1.4kg	0.32kg

* grid of raw points, no interpolation available

- ¹ Maximum permissible longitudinal error of measurement – according to ISO 10360-12:2016
- ² Maximum permissible probe deviation, size – according to ISO 10360-12:2016
- ³ Maximum permissible probe deviation, position – according to ISO 10360-12:2016
- ⁴ Maximum permissible probe deviation, shape – according to ISO 10360-12:2016
- ⁵ Scanning System Accuracy: L_{DIA} according to ISO 10360-8 Annex D
- ⁶ Weight without scanner
- ⁷ Maximum permissible error, probing – according to ISO 10360-2
- ⁸ Maximum permissible error, length measurement – according to ISO 10360-2
- ⁹ P_{Form.Sph.1}×25:ODS: Based on a part of the ISO-10360 standard



Hexagon Absolute Arm Machine Tool



Hexagon Absolute Arm Compact



Hexagon Absolute Arm Tube Inspection

Hexagon Absolute Arm 6-Axis Infinite Rotation

For Accurate Probe Measurements!



Hexagon Absolute Arm 6-Axis

Features

- Designed for accurate tactile measurements
- Carbon Graphite tube, RDS, intelligent TKJ, acoustic/haptic feedback, Absolute Encoders, Infinite Rotation in all axes, SpinGrip and SpinKnob (85 and 87 series), Zero G Counterbalance, SmartLock, interchangeable Control Packs for wireless connectivity
- Optional HP-L-8.9 laser scanner
- Compatible with InnovMetric's PolyWorks® Metrology Suite



6-Axis Compact Arm

Hexagon Absolute Arm COMPACT

For Highest Accuracy. Table Top Manual CMM Functionality



Hexagon Absolute Arm Compact

Features

- 1.2m measuring range with MPE E up to $5+L/65 \leq 15\mu\text{m}$ and MPE P of $6\mu\text{m}$
- Just place on table top and measure! No clamping or warm up time required
- Carbon Graphite tube, RDS, intelligent TKJ, acoustic and haptic feedback, Absolute Encoders, Infinite Rotation in all axes, Zero G Counterbalance, interchangeable Control Packs for wireless connectivity and other user aids
- Quick Measure tool: measures circle diameters, 2 planes distance...
- Low profile magnetic anchors / New Integrated Base Plate with 4 mounting options
- Available with ISO 10360-2 certification

Accessories for Hexagon Absolute Arm Compact	RA8312 Compact	RA8512 Compact
Calibration sphere, dust cover, TKJ probes (3, 6, 15mm), hard case, magnetic anchors, camera, work light, RDS, Quick Measure	Standard Included	
310mm Certified length bar, spin knob	Option	Yes
Weight (Arm only / Delivered Package)	10.2kg / 25kg	10.8kg / 30kg

Integrated Base Plate (4 Mounting Options)



Just put it on the table



Bolt to table



Magnetic anchor on steel surfaces/milling mc

Hexagon Absolute Arm 7-Axis Infinite Rotation Integrated Scanner

SI Series – The Standard for Laser Scanning and Probing!



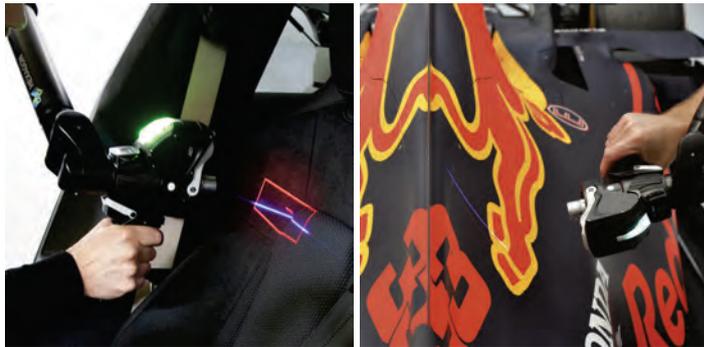
Hexagon Absolute Arm 87 Series with Hexagon Absolute Scanner ASI

Features

- 7-axis flexibility for versatile laser scanning
- Integrated scanner certified for total system accuracy
- New ASI laser scanner fully integrated with no cables along tubes, to capture data from almost any object surface
- Carbon Graphite tube, RDS, intelligent TKJ, acoustic and haptic feedback, Absolute Encoders, Infinite Rotation in all axes, SpinGrip and SpinKnob (85 and 87 series), Zero G Counterbalance, SmartLock, interchangeable Control Packs for wireless connectivity
- Compatible with InnovMetric’s PolyWorks® Metrology Suite
- Applications include Point cloud inspection, product benchmarking, reverse engineering, rapid prototyping, virtual assembly, etc.



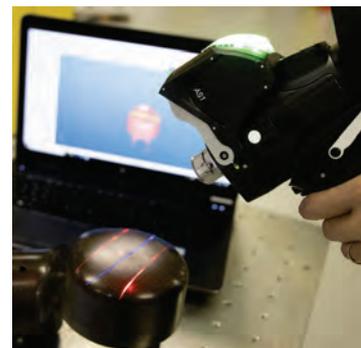
ASI with SHINE Technology



Freeform Structure Scanning



Scan complex parts with ease of use



Hexagon Tube Inspection System

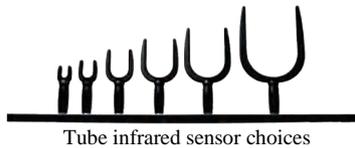
Combine choice of Hexagon Absolute Arm, Tube Probe + BendingStudio XT Software



Hexagon Absolute Arm
Dedicated T-Model (Heavier Base)

Features

- Fully functional high-end portable measuring arm with laser scanner has the versatility for tube analysis as well as other measuring tasks
- Measure flexible, malleable tubes of any length and of diameter up to 300mm
- Accurate scanning on tubes of a wide variety of materials, colours and surfaces without scanning the entire tube surface or using complex fixturing
- Position and orientation measurement of end holders, fittings and fixtures through scanner point cloud analysis with CAD adaptors
- Highly adaptable solution for high quality tube and wire measurements whether flexible or rigid, freeform or angular
- Highly repeatable and user-independent measurement results
- Full-speed scanning over WiFi and battery power for total portability
- Complete range of accessories includes additional probes, tube clamps, measurement tables and raisers to suit the working environment
- Open Bender Interface ensures easy compatibility with most CNC bender machines for direct production correction.
- Bending Simulation reduces correction loops by simulating proposed corrections within the software before physical application
- Fully certified to ISO-10360 certification



Tube infrared sensor choices



TubeInspect Turnkey Solution for High-End Tube Measurement



TubeInspect

Features

- Multiple-camera optical scanning system in a single-piece cell format
- HRC high-resolution camera delivers improved detail and feature analysis
- Available in industrial-sized TubeInspect P16.2 and smaller TubeInspect P8.2
- Fully Industry 4.0 compatible with possibility of integration within a larger robotic production cell
- Fast and detailed imaging with GigE camera technology, ensuring synchronic capture of the measuring object within milliseconds
- Innovative highly precise 3D glass reference surface offers the reliable stability required for shop-floor use

4 Tube/Pipe production and assemblies inspection, gauging and reverse engineering tasks

Reverse Engineering of Tube Assemblies: Non-contact infrared probes for rapid tube measurement. Touch probes for detailed geometric features. Creates accurate 3D model and save as 'golden part' for subsequent measurements.

Tube Production: Shop-floor interface to navigate TubeShaper through the Hexagon Absolute Arm. Barcode scanner compatibility to find/load data. Compatible with legacy software (Supravisio / DOCS) for continuity.

Tube and Pipe Inspection: Extract CAD nominals and compare with welded features probed after bending, for aligning to any part of a tube assembly. Compare results immediately against different alignment constraints.

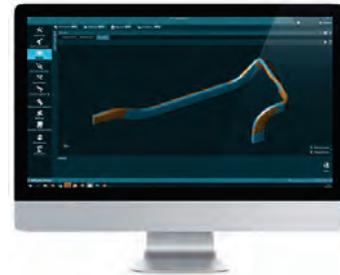
Tube Gauging: Advanced CAD engine for rapid import of CAD models of a fixture. Easy measurement of saddles and gates. Feature constructions to build virtual tube to test the setup. Portability for large gauges to be measured.

BendingStudio XT

Single Hub for Complete Tube and Wire Inspection

Features

- Complete end-to-end solution for tube and wire inspection and production control
- Links all data and processes related to the production of bent parts, from design and process planning to manufacturing and quality control, with an emphasis on metrological processes
- BendXtract technology allows quick collection and interpretation of measurement data and turn that into actionable customised reporting
- Carry out multiple inspection plans with individual measurement criteria for each part



BendingStudio XT



Specifications with Standard Hexagon Absolute Arm	
Measurement Technology	Infrared Tube Probe
Measurement Volume	1.2 to 4.5m
Arm Volumetric Accuracy	±0.1mm (1σ)
Tube Diameter	4 to 130mm
Bending Angle	1-340°
Operating Temperature	5 to 45°C
Storage Temperature:	-30 to 70°C
Relative Humidity	10 to 90% non-condensing
Power Requirement	Universal 110 to 240V

Absolute Arm Tube Model		
Model	8325T	7330T
EUNI ²	0.058mm	0.083mm
P _{SIZE} ³	0.025mm	0.036mm
L _{DIA} ⁴	0.066mm	0.089mm
P _{FORM} ⁵	0.048mm	0.068mm
Weight without probe	8.1kg	8.4kg
Max. reach	2.73m	3.23m
Specs per ISO 10360-12:2016		

Hexagon Absolute Arm for Large Volume Measurement

Extend Your Hexagon Absolute Arm Volume



GridLOK system creates an expanded measurement arena within which the arm can be repositioned anywhere with no undue loss of accuracy.

Hexagon Absolute Tracker World’s Best Laser Trackers

The Foundation of Absolute Accuracy

Absolute accuracy

- Absolute Interferometer (AIFM) combines the accuracy of an absolute distance meter (ADM) with the speed of an interferometer
- Scanning accuracy to within as little as 50µm
- Reflector single-point accuracy to within 20µm
- Patented Absolute Encoders ensure angular accuracy performance with no referencing before use
- Systems calibrated in ISO 17025-certified laboratories for accuracy specified to ISO 10360-10 standard

Absolute Productivity

- Non-contact measurement data collected at up to 1.2 million points and 300 lines per second
- Orient-to-Gravity for levelling and alignment tasks
- Ultra-large measurement volumes of up to Ø320m
- Real-time 1000Hz data rate
- Hidden-point measurement with a wireless probe can reduce measurement process time by up to 80%

Absolute Reliability

- Integrated MeteoStation environmental monitoring unit
- IEC-certified IP54 sealed unit for challenging environments
- Wide operating temperature range of -15 to 45°C
- Integrated mini variozoom delivers a constant field of view in any light conditions
- Full 24-month factory warranty and guaranteed 10 years of serviceability

Absolute Portability

- All-in-one integrated design
- Built-in WiFi with true access point functionality
- Portable design weighing as little as 7.3kg
- Independent hot-swappable battery power supply
- Convenient flight cases for simple transportation



ATS600

Groundbreaking direct scanning laser tracker, delivering metrology-grade measurement from a distance of up to 60m

AT960

Flagship model offering full 6DoF measuring functionality capable of both manual and automated inspections

AT930

Premium 3D tracker for high-accuracy reflector measurements that can support a range of applications

AT500

Ultra-long-range tracker designed for rugged use in the most challenging measurement environments

Hexagon Absolute Tracker Groundbreaking Technology

200 Years of Technical Innovation and R&D

Absolute distance meter

The foundation of laser tracker distance measurement delivers highly accurate 3D measurements over distances of up to 160 metres and was first introduced with the LTD500 in 1995.

Applicable for ALL Hexagon Absolute Trackers.

Absolute Interferometer

Combining interferometer and distance meter technology, the Absolute Interferometer (AIFM) is the foundation of 6DoF measurement, first introduced with the groundbreaking AT901 in 2008.

Applicable for AT960, ATS600.

Enhanced Wave Form Digitiser

An extension of the Wave Form Digitiser technology pioneered by Hexagon in surveying applications, the Enhanced WFD was introduced in 2019 with the ATS600 to deliver the world's first metrology-grade direct scanning laser tracker.

Applicable for ATS600.

PowerLock

Automatic beam-targeting was introduced with the AT901 in 2009. This active vision technology made laser tracker operations simple and intuitive, reducing training needs and cutting measurement process times by up to 30 percent.

Applicable for ALL Hexagon Absolute Trackers.

SHINE technology

The Systematic High-Intelligence Noise Elimination introduced with the Absolute Scanner AS1 allows for measurement with no hidden settings that limit speed and scan-line width in order to deliver peak accuracy – all the performance, all of the time.

Applicable for AT960 with AS1.

Automation

Automated inspection based on both 6DoF and 3D laser tracker technology is ground that was broken with Hexagon's LTD systems in the 1990s and has continued through to the development of the AT960 and ATS600 systems.

Applicable for AT960, ATS600.

Handheld sensors

Handheld sensors operated at the point of measurement in conjunction with a laser tracker have delivered enhanced measurement possibilities such as hidden point inspection and point cloud data acquisition since 2004.

Applicable for AT960.

Modular concept

The unique modular construction of the Absolute Scanner AS1 is the basis for the first ever cross-platform scanner, delivering high performance within both laser tracker and portable measuring arm-based systems.

Applicable for AT960.

7DoF control

Allowing for direct control of any robot or numerical control system in real-time, Absolute Tracker 7DoF metrology based on the state-of-the-art EtherCAT protocol has pioneered the development of automated production built on metrology-grade accuracy.

Applicable for AT960.

Wide-angle reflector

The Super CatEye retroreflector is a unique solution for 3D point measurement, using special materials and a high-accuracy tracker to allow for an increased range of retroreflector measurement without tracker repositioning.

Applicable for ALL Hexagon Absolute Trackers.

Hexagon Absolute Tracker All Models @ a Glance!

		AT960	AT930	ATS600	AT500
Measurement Distance	5m	Typical $\pm 23\mu\text{m}$, MPE $\pm 45\mu\text{m}$			
	10m	Typical $\pm 38\mu\text{m}$, MPE $\pm 75\mu\text{m}$			
	20m	Typical $\pm 68\mu\text{m}$, MPE $\pm 135\mu\text{m}$			
Absolute Angular Performance e_T ¹		$\pm 15\mu\text{m} + 6\mu\text{m/m}$			
AIFM Absolute Distance Performance		$\pm 0.5\mu\text{m/m}$			
Dynamic Lock-on		$\pm 10\mu\text{m}$			
Inclination Sensor		$\pm 1.0\text{arcsec}$			
Orient to Gravity U_z		$\pm 15\mu\text{m} + 8\mu\text{m/m}$			
Timestamp Accuracy		$< 5\mu\text{sec}$			
Length Measurement 1.5'' RRR $E_{\text{Uni:0:LT,MPE}}$ ²		$\pm 21\mu\text{m} + 8.5\mu\text{m/m}$			
Length Measurement T-Probe $E_{\text{Uni:195:LT,MPE}}$		$\pm 42\mu\text{m} + 7.7\mu\text{m/m}$			
Length Measurement AS1 $E_{\text{Uni:0DR:LT,MPE}}$		$\pm 50\mu\text{m}$			
Length Measurement LAS $E_{\text{Uni:0DR:LT,MPE}}$		$\pm 60\mu\text{m} / \pm 26\mu\text{m} + 4\mu\text{m/m}$ ($> 8.5\text{m}$)			
Length Measurement LAS-XL $E_{\text{Uni:0DR:LT,MPE}}$		$\pm 150\mu\text{m}$			
Length Measurement B-Probe $E_{\text{Uni:0:LT,MPE}}$		$\pm 300\mu\text{m}$			
T-Mac Positional Accuracy		$\pm 15\mu\text{m} + 6\mu\text{m/m}$			

Length Measurement (Length Test in μm)

Measurement Distance	AT960/930/500		ATS600		T-Probe		AS1		LAS		LAS-XL	
	Typical	MPE	Typical	MPE	Typical	MPE	Typical	MPE	Typical	MPE	Typical	MPE
5m	± 32	± 64	± 40	± 81	± 40	± 81	± 25	± 50	± 30	± 60	± 75	± 150
10m	± 53	± 106	± 53	± 106	± 60	± 119	± 25	± 50	± 33	± 66	± 75	± 150
20m	± 96	± 191	± 96	± 191	± 98	± 196	± 25	± 50	± 58	± 106	± 75	± 150

Distance Measurement (Ranging Test in μm)

Measurement Distance	AT960/930 (IFM)		AT960/930 (ADM) / AT500		ATS600	
	Typical	MPE	Typical	MPE	Typical	MPE
1.5 to 5 m	± 1	± 1	± 7	± 14	± 71	± 142
1.5 to 10 m	± 1	± 3			± 72	± 143
1.5 to 20 m	± 3	± 5			± 76	± 152
1.5 to 30 m	± 4	± 8			± 83	± 165
1.5 to 40 m	± 5	± 11			± 92	± 183
1.5 to 50 m	± 8	± 15			± 102	± 203

	AT960	AT930	ATS600	AT500
Measurement Range (3D)	XR / LR: 0 to 80m MR: 0 to 20m SR: 0 to 6m	0 to 80m	0.8 to 80m 1.5 to 60m (Direct Scanning)	0.8 to 160m
Tracker Size / Weight	477x258x258mm / 14.2kg			477x261x238mm / 13.6kg
Controller Size / Weight	249x148x59mm / 1.65kg			Built-in Controller
Laser Class	Class 2 Laser Product in accordance with IEC 60825-1 Second Edition (2014-05)			
Overview Camera	5MP / 10-degree FOV			
PowerLock Range	60m			80m
ISO 17025 Certified	Yes			
Warranty	2 years extension possible with Customer Care Packages			
Operating Temperature	0 to +40°C			-15 to +50°C
Relative Humidity	Max. 95% non-condensing			
Operating Elevation	-700 to +5500 m			
Dust / Water	IP54			
Cable / Wireless	TCP/IP (Cat5) / WLAN (IEEE 802.11n)			
Battery Type	Lithium-ion battery Swappable			
Battery Runtime	6 hours			6 hours
Data Output	1000Hz			100Hz

Hexagon Absolute Tracker All Models @ a Glance!



AS1



LAS



LAS-XL

	AS1	LAS	LAS-XL
Scanner Size / Weight	347x147x172mm / 1.19kg	300x201x140mm / 0.94kg	300x201x140mm / 0.96kg
Controller size / Weight	145x63x138mm / 0.95kg	226x146x91mm / 1.9kg	226x146x91mm / 1.9kg
Standoff	165mm	180mm	700mm
Working Range	±50mm	±40mm	±300mm
Scan Width (At Standoff)	Max 150mm	Max 220mm	Max 468mm
Maximum Sampling Rate	1.2 million pts/sec	150,000 pts/sec	143,000 pts/sec
Maximum Line Frequency	300Hz	100Hz	100Hz
Point Density (At Standoff)	Min 0.037mm	Min 0.013mm	Min 0.045mm



T-Probe



B-Probe^{plus}

	T-Probe	B-Probe ^{plus}
Size / Weight	310 x 129 x 70 mm 0.65 kg	230 x 80 x 54 mm 0.14 kg
Features	Cable-free operation, Multiple programmable buttons, Instant visibility feedback, Automatic stylus recognition, Multiple stylus mounting positions, Acoustic feedback	Cable-free operation
Battery type	1 x Lithium-ion swappable	2 x AAA (NiMH) swappable
Typical battery runtime (single charge)	> 5 hours	> 6 hours

	AT960	AT500
Measurement Range with Probe/Scanner (6D)	XR: 1.2 to 30m LR: 1.2 to 20m MR: 1.2 to 10m SR: 1.2 to 5m	1.6 to 12m

¹ Angular Performance Transverse e_T according to ISO 10360-10:2016 Annex E, with respect to an MPE for the Location Error ($L_{Dia,2x1:P\&R:LT,MPE}$) in accordance with chapter 6.3 of ISO 10360-10:2016 of $30\mu m + 12\mu m/m$
² In accordance with ISO 10360-10:2016 Chapter 6.4, Table 4, positions 1 to 35
³ Standard deviation (1σ) of a best-fit plane (78% albedo), distance 1.5 to 30m, standard measurement mode, target aligned
⁴ Maximum deviation (MPE) of the absolute position of a plane (78% Albedo), 1.5 to 30m, 0 to $\pm 45^\circ$ incidence angle
⁵ In accordance with ASTM E3125-17 Table 2
⁶ In accordance with ASTM E3125-17 Tables 3 and 4
⁷ At default point-to-point and line-to-line distance, measurement distance 10m

Hexagon Absolute Tracker AT960/AT930

Ultra-Compact High-Speed Large-Volume Measurements



Hexagon Absolute Tracker AT960



Hexagon Absolute Tracker AT930

Features

- Robust all-in-one Laser Tracker for Absolute Portability, Speed and Accuracy
- Measurement volumes of 12mØ (AT960-SR) to 160mØ (AT960-LR/-XR)
- Leica Absolute Interferometer (AIFM) ensures precise dynamic measurements to a moving target with dynamic performance at 1kHz data output
- PowerLock instantly re-establishes interrupted beams for ultimate ease-of-use
- Complete 6DOF inspections with probes, scanners and reflectors and for automation
- Wireless communication and battery option. Intuitive touchscreen minimising potential for user error
- IP54 ingress protection against dust and contaminants - allows use in harsh environments
- Integrated environmental unit to compensate for external temperature, pressure and humidity factors
- High-resolution colour overview camera (OVC) for static hidden point devices or documentation
- Orient to gravity (OTG) measures with Z-axis aligned to gravity for levelling/alignment tasks
- Fully ready for automated inspection, assembly and production within a robotic setup when paired with sensors such as the Absolute Scanner AS1, Leica T-Scan 5 and Leica T-Mac
- Ideal for Aerospace, Automotive, Shipbuilding, Manufacturing and many more sectors
- Fully supported by InnovMetric's PolyWorks® Metrology Suite



Automotive



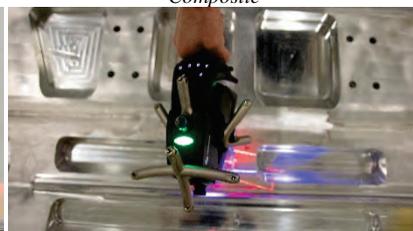
Composite



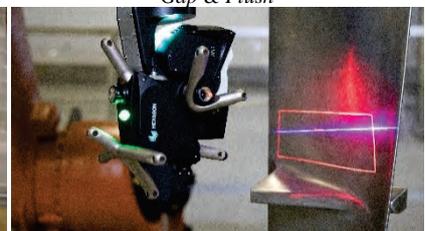
Gap & Flush



Automation



Mold & Die



Aerospace

Hexagon Absolute Tracker Scanning and Probing Solutions

Laser Scanning Technology with ASI / LAS / LAS-XL



ASI

Features

- SHINE technology for cleaner, higher-quality data, collected faster, even on challenging surface types and finishes
- Wide 150mm scan line at mid-range for 300 line/s data collection speed
- Automation ready with impressive performance on default exposure settings, as well as high-speed data collection of up to 1.2 million points per second
- Ideal for a variety of automated manufacturing applications, from systematic inline inspection to statistical checks in the quality room



LAS

Features

- Lightweight, ergonomic and designed for ease of use in harsh shop-floor environments
- Flying-dot principle delivers excellent performance for freeform surface inspection, automatically adjusting laser intensity without user intervention
- Automatically recognised by the laser tracker for seamless changes between reflector, probe and scanner measurement
- IP50 for dust ingress protection and battery power option



LAS-XL

Features

- Ultra-large-volume surface scanning with width of up to 600mm and standoff at up to 1000mm
- Multi-surface scanning is effortlessly handled with the ‘flying-dot’ principle
- Scan deep recesses and hidden areas
- Accuracy to within 150µm for metrology-grade performance
- Battery power allows the LAS-XL to be used in areas where large-scale scanning is needed most

Leica T-Probe Dynamic High-Speed Probe



Leica T-Probe

Features

- Completely wireless solution for the probing of hidden and hard-to-reach points
- Minimal setup times and station changes combined with a high point-acquisition rate, automatic stylus recognition and individually assignable multi-function buttons allows for high-productivity single-point data acquisition
- Flexible top-performance probing solution with a range up to 30m from the tracker
- Small, light, user-friendly, cable-free, battery powered and more accurate than other handheld probes
- Large armless measurement volume to 60m; Relocation volume 160m
- Light, user-friendly and more accurate than other hand-held probes
- Accuracy $U_{xyz} 0.035\text{mm}^1$
- Increased acceptance angle: Pitch $\pm 45^\circ$, Yaw $\pm 45^\circ$, Roll 360°
- Accepts Renishaw styli. Output 1,000 pts/s rate
- Precise quick auto-stylus change recognition without re-calibration
- Cable-less operation. Typical 12 hours runtime on 1 battery charge
- Multiple programmable buttons: instant visibility feedback, auto-stylus recognition, multiple styli mounting positions, acoustic feedback

¹. Additional T-Probe uncertainty to be added per ISO/IEC Guide 98-3:2008 to the existing Hexagon Absolute Tracker AT960 “ U_{xyz} ” uncertainty for a complete “ U_{xyz} ” uncertainty up to 25m distance.

Hexagon Absolute Tracker AT500 *NEW!*

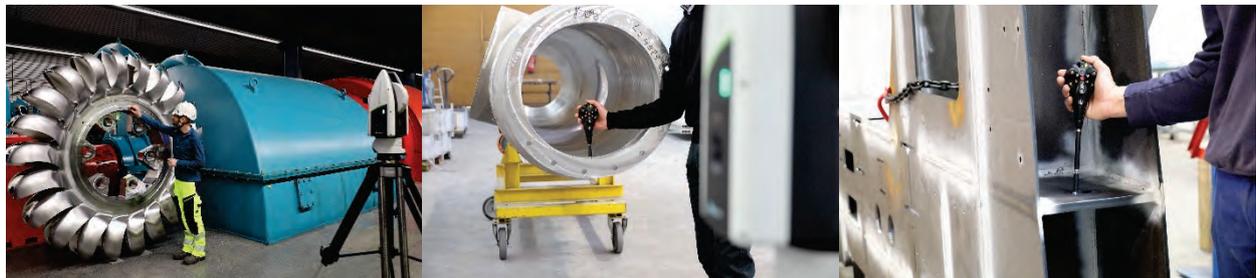
Measure Anywhere with Enhanced Productivity

Features

- From 0.8m to 320mØ ultra-large measurement volume
- All-in-One Integrated Design with built-in battery-powered controller unit, integrated wireless connectivity, environmental monitoring, all-day battery power, HD overview camera and ergonomic carry handle
- Smart Connectivity with built-in WiFi with true access-point functionality
- Bluetooth Control via the AT500 Connect app for quick settings adjustments over Bluetooth direct from a smartphone or tablet
- PowerLock automatically re-establishes interrupted line of sight within a wide field of view with no user interaction required
- Continuous measurement sampling rate at 100Hz
- Probing with the new cableless, battery-powered Leica B-Probe^{plus} with customisable hidden-point capability
- Hassle-free setup process from transport case to large-scale measurement in just moments
- IP54-rated protection and extended operating temperature range (-15 to +50°C) for working under challenging conditions
- Fully supported by InnovMetric's PolyWorks® Metrology Suite



Hexagon Absolute Tracker AT500



Dimension Check on Propeller

Mounting Hole Location Check

Hidden Point Probing



Leica B-Probe^{plus}

Features

- Dedicated handheld probing tool for Hexagon Absolute Tracker AT500
- Gather hidden 3D points across a large measurement volume
- Cableless, battery-powered, up to 6 hours runtime

Leica B-Probe ^{plus} <i>NEW!</i>	
Meas. Vol Ø	24m
Relocation Vol Ø	Up to 320m
Battery Power	> 6 hours per charge
Hidden Point Capability	150mm

Hexagon Absolute Tracker ATS600 **First Ever Direct Scanning!**

Features

- Combines reflector, target accessories and DRO with Wave Form Digitiser (true submillimeter scanning from up to 60m away with accuracy within 300µm)
- Ultimate high-speed direct scanning inspection for large parts and surfaces, hitherto impractical to cover with handheld scanners
- Fast process opens up new applications for metrological quality control
- Measurement data delivered to metrology software at data rate of up to 1000Hz
- Familiar and easy to use like traditional laser tracker. Targets easily identified and results delivered and processed efficiently through established workflows
- Ideal for automated installations with minimal user intervention required
- Data point-density fully configurable. User may choose fast process rates to scan whole volume or choose higher density scans for certain specific segments for higher resolution and accuracy level per their application
- Fully supported by InnovMetric’s PolyWorks® Metrology Suite



Hexagon Absolute Tracker ATS600



Aerospace



Energy



Transportation

	Hexagon Absolute Tracker ATS600
Reflector Measurement Absolute Angular Performance ¹	±15µm+6µm/m
Reflector Measurement Length Measurement (E _{Uni:0:LT,MPE}) ²	±100µm
Non-Contact Measurement Range Noise ³	< 80µm
Non-Contact Measurement Absolute Accuracy ⁴	<±300µm
Reflector Measurement Range	0.8 to 80m
Non-Contact Measurement	1.5 to 60m
Scanning Rate	1kHz
Scanning Speed ⁵	< 10sec/m ² in Fast Mode; < 135sec/m ² in Standard Mode
Dust/Water / Operating Temperature	IP54 (IEC 60529) / 0°C to 40°C
Relative Humidity	Max 95% (non-condensing)
Environmental Monitor	Temperature, pressure and humidity
Cable / Wireless Interface	TCP/IP (Cat5) / WLAN (IEEE 802.11n)
Overview Camera	4:3 IR enhanced image ≈ 10° FOV
Power	AC power supply, 8-hour Lithium-ion battery
Laser	Class 2 (IEC 60825-1 – Second Edition 2014-05)
Width x Height x Depth / Weight	Machine: 258x477x258mm / 14.2kg Controller: 148 x 249x59mm / 1.65kg

¹. Angular Performance Transverse e_T according to ISO 10360-10:2016, with respect to an MPE for the Location Error (L_{Dia.2x1:P&R:LT,MPE}) in accordance with chapter 6.3 of ISO 10360-10:2016 of ±30µm+12µm/m.

². In accordance with ISO 10360-10:2016 Chapter 6.4, Table 4, positions 1 to 35.

³. Standard deviation (1σ) of a best-fit plane (78% Albedo), distance 1.5 to 30m, standard measurement mode, target aligned.

⁴. Maximum Deviation (MPE) of the absolute position of a plane (78% Albedo), 1.5 to 30m, 0 to ± 45° incidence angle.

⁵. At default point-to-point and line-to-line distance (10m).

StereoScan neo Superior Resolution and Accuracy Model



Hexagon StereoScan neo

- Innovative Smart Data Capture for data acquisition powered by either 8- or 16-MP twin digital cameras at extremely high speed without compromising data quality with variable resolution
- Smart Phase Projection with cutting-edge fringe projection pattern for highest quality data even with challenging surfaces
- Variable Light Projection (VLP) allows the generated measurement results to be instantly projected back onto the measurement surface, for the easy colour-coded visualisation of deviations from CAD right on the part being measured
- Ready for automated robotic inspection thanks to rigid design and double carbon frame.
- Accessories such as turntable and turn-tilt units allow for semi-automated scanning
- Combinable with photogrammetry systems.
- Compatible with InnovMetric’s PolyWorks® Metrology Suite

	R8 (8MP)	R16 (16MP)
Camera Sensor	Monochrome, CCD progressive scan 4/3”	Monochrome, CDD progressive scan 1.7”
Camera Resolution	2 x 8 147 712 pixel (3296 x 2472)	2 x 15 720 448 pixel (4864 x 3232)
Projection Unit	Digital Projector	
Light Source	3 x 100W high-power LEDs (red + green + blue)	
Acquisition Time	Min 1 second	
Sensor Weight	12kg ¹	
Power Supply / Control Unit	AC 110/230 V, 50-60 Hz, 600 W / Integrated, USB 3.0	
Operating System	Windows 10 or 11, 64-bit	
Probing	Compatible with MI.Probe mini	

Measurement Specifications

	Outer Camera Position				Inner Camera Position		
	Triangulation Angle 30° Base Length 450mm Working Dist. 840mm				Triangulation Angle 30° Base Length 150mm Working Dist. 350mm		
R8 (8MP)							
Field of View ²	L 350mm	L 550mm	L 850mm	L 1100mm	S 75mm	S 125mm	S 200mm
Field of View Size ³	280x210mm	420x320mm	700x560mm	850x700mm	65x50mm	100x75mm	160x125mm
Measuring Depth ⁴	176mm	270mm	430mm	550mm	36mm	60mm	100mm
X, Y Resolution ⁵	86µm	128µm	211µm	256µm	20µm	30µm	49µm
Sphere Spacing Error	10µm	16µm	30µm	42µm	5µm	6µm	8µm
Length Measuring Error	20µm	28µm	60µm	84µm	10µm	15µm	18µm
Probing Error Size	6µm	12µm	16µm	21µm	4µm	6µm	6µm
Probing Error Form	7µm	12µm	16µm	18µm	5µm	6µm	6µm

	Outer Camera Position				Inner Camera Position		
	Triangulation Angle 30° Base Length 450mm Working Dist. 840mm				Triangulation Angle 30° Base Length 150mm Working Dist. 350mm		
R16 (16MP)							
Field of View ²	L 350mm	L 550mm	L 850mm	L 1100mm	S 75mm	S 125mm	S 200mm
Field of View Size ³	285x190mm	460x310mm	710x500mm	940x700mm	70x50mm	90x60mm	160x110mm
Measuring Depth ⁴	176mm	280mm	430mm	550mm	20mm	54mm	100mm
X, Y Resolution ⁵	58µm	94µm	146µm	193µm	15µm	19µm	33µm
Sphere Spacing Error	10µm	16µm	30µm	32µm	5µm	6µm	8µm
Length Measuring Error	20µm	28µm	60µm	64µm	8µm	15µm	18µm
Probing Error Size	6µm	12µm	16µm	18µm	4µm	6µm	6µm
Probing Error Form	7µm	12µm	16µm	18µm	5µm	6µm	6µm

¹ Weight may vary depending on the measuring fields. ² Designation of the scanner bases (S, L) and the diagonal (Z) in the centre of the measuring volume. ³ Lateral expansion (X x Y) in the centre of the measuring volume. ⁴ Depth of the measuring volume (Z). ⁵ Values for the lateral resolution have been calculated theoretically (ratio of the size of the FOV and number of pixels of the camera chip).

SmartScan Powerful and Compact 3D Scanning



Hexagon SmartScan



MI.Probing with SmartSCAN and stereoSCAN

- Smart Data Capture technology allows for high-speed data acquisition at extremely high levels of detail
- Compact and low weight design for work in the most challenging workshop conditions
- High-tech carbon-fibre structure for extremely stable and reliable performance even under temperature fluctuations
- Available in standard twin 5MP and high-end twin 12MP camera arrangements; Fully upgradeable modular system configuration
- Ideal for large complex surface geometries and fragile or deformable parts
- Easy changeable measuring fields when combined with high-end photogrammetry
- Compatible with InnovMetric’s PolyWorks® Metrology Suite

	R5 (5MP)	R12 (12MP)
Camera Sensor	Monochrome, CDD progressive scan, 2/3”	Monochrome, CMOS, 1.1”
Camera Resolution	2 x 5 013 504 pixels (2448 x 2048)	2 x 12 368 896 pixels (4112 x 3008)
Projection Unit	Miniaturized Projection Technique (MPT)	
Light Source	100W high-power LED ¹	
Acquisition Time	Min 1 second	
Sensor Weight	4kg	
Power Supply / Control Unit	AC 110/230V, 50-60Hz, external, 150W / External, USB 2.0	
Operating System	Windows 10 or 11, 64-bit	
Probing	Compatible with MI.Probe mini	

Measurement Specifications

R5 (5MP)	Triangulation Angle 27° Base Length 470mm Working Dist. 1000mm				Triangulation Angle 30° Base Length 240mm Working Dist. 370mm		Triangulation Angle 20° Base Length 470mm Working Dist. 1500mm	
Field of View ² (for M)	125mm	200mm	500mm	850mm	S 60mm	S 125mm	L 750mm	L 1550mm
Field of View size ³ in mm	105x85	160x130	380x310	650x565	50x40	100x80	560x470	1200x750
Measuring Depth ⁴	66mm	100mm	244mm	420mm	30mm	60mm	360mm	750mm
X, Y Resolution ⁵	43µm	64µm	153µm	266µm	20µm	40µm	230µm	485µm
Sphere Spacing Error	10µm	11µm	22µm	44µm	5µm	7µm	61µm	220µm
Length Measuring Error	20µm	22µm	44µm	88µm	10µm	14µm	122µm	440µm
Probing Error Size	7µm	9µm	11µm	22µm	6µm	7µm	31µm	110µm
Probing Error Form	7µm	8µm	11µm	22µm	5µm	7µm	31µm	110µm

R12 (12MP)	Triangulation Angle 27° Base Length 470mm Working Dist. 1000mm				Triangulation Angle 29° Base Length 260mm Working Dist. 500mm			
Field of View ²	350mm	450mm	750mm	1000mm	SL 90mm	SL 200mm	SL 300mm	SL 500mm
Field of View size ³ in mm	285x205	380x275	590x435	825x630	70x55	145x105	240x160	420x325
Measuring Depth ⁴	180mm	240mm	370mm	500mm	44mm	90mm	144mm	250mm
X, Y Resolution ⁵	69µm	92µm	143µm	201µm	17µm	35µm	57µm	102µm
Sphere Spacing Error	16µm	20µm	30µm	44µm	6µm	9µm	12µm	21µm
Length Measuring Error	36µm	40µm	60µm	88µm	15µm	18µm	24µm	42µm
Probing Error Size	9µm	10µm	15µm	22µm	6µm	6µm	8µm	15µm
Probing Error Form	9µm	10µm	15µm	22µm	6µm	6µm	8µm	15µm

¹ ANSI Lumen describes the value of the luminosity output of the light source adapted to the camera sensitivity. ² The camera positions are determined by using different CRP (carbon-fibre reinforced plastic) scanner bases, designated S, M, L and the diagonal in the centre of the measuring volume. ³ Lateral expansion (X x Y) in the centre of the measuring volume. ⁴ Depth of the measuring volume (Z). ⁵ Values for the lateral resolution have been calculated theoretically (ratio of the size of the FOV and number of pixels of the camera chip).

PrimeScan For Simple, Precise Scanning



- Innovative fringe projection technology delivering high luminous power and excellent projection quality
- Compact and lightweight design perfect for scanning in special application areas or in difficult to access parts of the shop floor
- Scans glossy and dark surfaces without pre-treatment
- Automated measurement and easy data acquisition possible within both smaller and larger volumes
- Smart Data Capture technology allows for high-speed data acquisition at extremely high levels of detail
- 8 configurations for diverse range of measurement tasks
- Short working distance ideal for applications in narrow environments
- Compatible with InnovMetric’s PolyWorks® Metrology Suite

	R5 (5MP)	R8 (8MP)
Camera Sensor	Monochrome, CMOS 2/3”	Monochrome, CMOS 1”
Camera Resolution	2 x 5013504 pixels (2448 x 2048)	2 x 7990272 pixels (3264 x 2448)
Projection Unit	Miniaturized projection technique	
Projection Resolution	28723200 pixels (6144 x 4675)	
Light Source	Blue 100W high-power LED	
Acquisition Time	Min 1 second	
Sensor Weight	3.8kg ¹	
Power Supply / Control Unit	AC 110/230V, 50-60Hz, external, 150W / Integrated, USB 3.0	
Operating System	Windows 10 or 11, 64-bit	
Probing	Compatible with MI.Probe mini	

Measurement Specifications

R5 (5MP)	Short Working Distance Triangulation Angle 26° Working Dist 370mm				Long Working Distance Triangulation Angle 18° Working Dist. 540mm
	50mm	125mm	200mm	400mm	700mm
Field of View ²	40x30mm	100x80mm	150x125mm	300x275mm	500x450mm
Field of View Size ³	24mm	64mm	100mm	200mm	350mm
Measuring Depth ⁴	16µm	40µm	63µm	125µm	208µm
X, Y Resolution ⁵	4µm	7µm	12µm	20µm	56µm
Sphere Spacing Error	10µm	16µm	24µm	40µm	112µm
Length Measuring Error	6µm	6µm	6µm	10µm	28µm
Probing Error Size	4µm	6µm	7µm	10µm	28µm
Probing Error Form					

R8 (8MP)	Short Working Distance Triangulation Angle 26° Working Dist. 370mm		Long Working Distance Triangulation Angle 18° Working Dist. 540mm
	100mm	450mm	650mm
Field of View ²	80x60mm	350x290mm	500x400mm
Field of View Size ³	50mm	222mm	320mm
Measuring Depth ⁴	27µm	109µm	155µm
X, Y Resolution ⁵	6µm	25µm	52µm
Sphere Spacing Error	14µm	50µm	104µm
Length Measuring Error	8µm	13µm	26µm
Probing Error Size	6µm	13µm	26µm
Probing Error Form			

¹ Weight may vary depending on the measuring fields. ² Each field of view (FOV) denotes a different scanner. ³ Lateral expansion (X x Y) in the centre of the measuring volume. ⁴ Depth of the measuring volume (Z). ⁵ The values for the lateral resolution have been calculated theoretically (ratio of the size of the FOV and number of pixels of the camera chip).

PartInspect L Automated Inspection Powered by SLS Technology



PartInspect L

- Straight-forward measurement cells that simplify and accelerate repetitive inspection tasks
- Move vital inspection processes into the world of smart manufacturing with the minimum of expertise and effort
- OfflineProgramming allows for a wide range of measurement preparation functionality within an easy-to-learn user interface with an intelligent guidance process
- Specialised ‘one button’ interface for simple execution of prepared measurement programs
- User guidance through robot pose and scan path planning using smart process automation
- In-process planning creates scan plans up to 16 times faster than fully manually programmed systems
- Available in HiRes, HiEnd or Efficient configurations based on StereoScan neo R8/R16 or PrimeScan
- Compatible with InnovMetric’s PolyWorks® Metrology Suite

Applications of Structure Light Scanner Solutions



Automotive



General Manufacturing



Tooling, Mould and Die



Aerospace



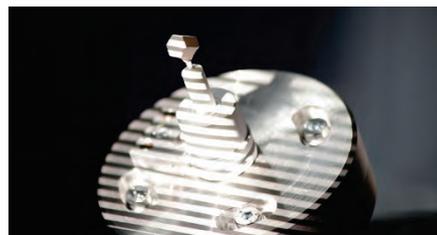
Heavy Industry



Power & Energy



Arts & Culture



Other Unique Applications

LaserGauge® DSP Handheld Sensors with Integral Processors



HS702

- Smallest most rugged DSP sensor
- High volume applications eg. automotive and aerospace gap and flush
- Automatic Gain Adjustment measures all colour surfaces. Image optimized through sophisticated gain algorithm
- Available in either Red or Blue laser



HS703

- Fastest, most versatile DSP sensors
- Horizontal scanning resolution of 1280 surface points within FOV; 2.5X better than most other profilers on the market
- Run complex inspections or use as GO/NO GO Gauge. Full range of aerospace applications
- Available in either Red or Blue laser



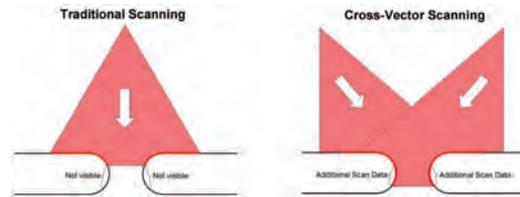
HS763

- Equipped with two blue lasers to scan transparent, translucent surfaces and opaque surfaces
- Plug a TS800 into the HS763 and use it as a controller
- Ideal for automotive body panels, headlamps, tail lamps, window glass, chrome, etc.



HS761

- Complete surface profile
- Unique cross-vector scanning with multiple lasers/views at crossing angles, to see around edges of radii to the vertical tangent and beyond
- Integral barcode reader scans a VIN/identifying number for traceability of part or inspected assembly



Cross-Vector Scanning (HS761)



Fully portable (HS703)

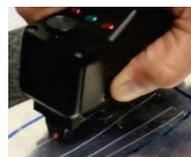
	HS702	HS761	HS703	HS763
Processor	Digital Signal Processor, 1GHz Speed; measures in < 1 second			
Size (WxHxL)e	58x97x257mm	91x114x257mm	91x97x257mm	91x150x257mm
Weight / (with battery)	595g / (709g)	907g / (992g)	737g / (822g)	964g / (1077g)
Colour Display	2.4"	3.5" touchscreen	3.5" touchscreen	3.5" touchscreen
User Interface	2 sets of 3 LED's, 5-Way Joystick and 2 Buttons			
Communications	Wireless – 2.4GHz with USB Stick; Cable – USB 2.0A to Mini 5-pin USB, 6' length			
Operating Modes	Gauge uses one algorithm per scan to calculate multiple measurements and display values. Routine designed with LG Works to measure different features on an assembly with files sent to the sensor.			
Memory / Battery	8GB of data/scans/routines / Rechargeable lithium-ion			
FOV Options	30mm	38mm	30mm	38mm
Horizontal Scanning Res	20µm	30µm	25µm	30µm
Depth Accuracy	±20µm	±25µm	±20µm	±25µm
Shock Protection	Cast urethane housing			
Environment	0° – 70°C			



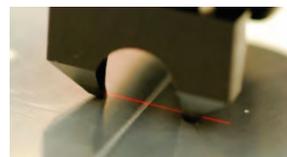
Pop-Top/Burst Disc Score Depth



Contour



Scratches



LaserGauge® USB Sensors Ultra-Fast, Hi-Resolution 2D Scanning



TS800



HS730LE



HS733LE



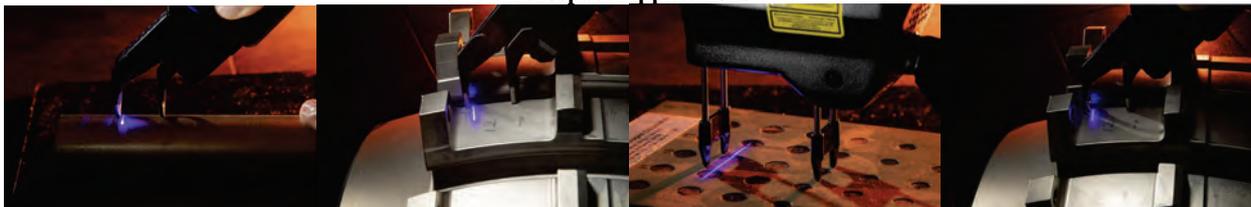
RS750

- Blue laser inspects and measures small features in hard-to-access areas even on shiny or opaque surfaces
- Unique removable standoff provides guidance for correct alignment to ensure accurate measurement
- Small and light, narrow tapered stem for access to highly restricted areas
- Measurements: Edge Radius, Break Angles, Chamfer Angles, etc.
- Available in either Red or Blue laser
- Inspects leading edge of aircraft and power system engine blades/vanes
- Scans both sides of blade simultaneously and plots whole profile around blade radius for comparison to nominals. Blade thickness and edge radius can also be analysed
- Real-time raw video and plotted profile display
- Measurements recorded when trigger is released
- Out-of-spec conditions flagged in colour
- Measurements: Blade Thickness, Profile Deviation, Edge Radius
- High-res profiling for on-line, robotic and remote customer applications with LG algorithms
- Rugged, compact, with mounting ports for positioning sensor. Single USB power and data cable
- Multiple sensors can be calibrated, synchronized to capture scans from every angle simultaneously to view 360° around a complex part

	TS800			HS730LE	HS733LE	RS750			
Sensor Type	USB – Handheld			USB 2.0, Windows		USB - Remote Mounted			
Size (WxHxL)	44x66x165mm			46x79x239mm	44x114x191mm	41x64x89mm			
Weight	184g			425g	340g	227g			
User Interface	2 sets of 3 feedback LED's (Red Laser), 3 Pitch/Yaw feedback LED's (Blue Laser)			3 LED's, 2 tactile buttons, finger trigger		-			
Communications	USB 2.0A to Mini 5-Pin USB, 6' straight cable (can be increased with power cable or hub)								
FOV	13mm	25mm	51mm	6mm	4mm	13mm	30mm	50mm	65mm
Horizontal Scanning Res	10µm	20µm	41µm	10µm	5µm	10µm	20µm	38µm	50µm
Depth Accuracy	6µm	10µm	25µm	12µm	12µm	20µm	20µm	37µm	51µm
Shock Protection	Cast urethane housing								
Environment	0° – 70°C								

Applications

Aerospace Applications



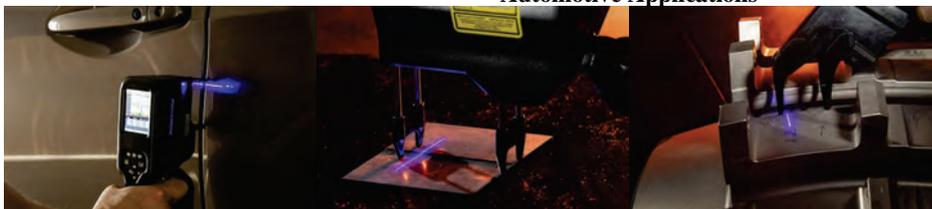
Scratches, Gouges, & Dents

Radius, Break Edge, Chamfers

Fasteners

Pitting & Corrosion

Automotive Applications



Gap & Flush

Laser Welds and Lap Welds

Sheet Metal – Roof to Door



Curved Hood

LaserGauge® Controllers Powerful User Functionality



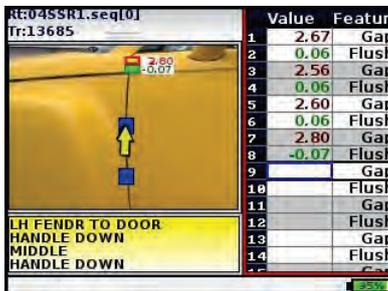
LG7000



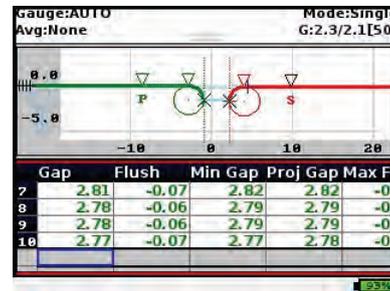
LG5000

- Used with all LaserGauge® controller-based and USB sensors
- 7-inch graphical touchscreen display
- Supports maximum functionality of the sensor and is rugged and portable for measurements to be made anywhere
- Measurement data and scan images saved to on-board memory for analysis on the controller or transferred to a computer using a USB cable or a wireless ZigBee connection
- Integrated barcode scanner and reader
- Used with all LaserGauge® controller-based and USB sensors
- Smallest, lightest LG controller 539g
- 3.5” colour touchscreen and joystick
- USB, null modem cable or wired/wireless Ethernet comms
- 4-way rotational screen; High contrast scanning on dissimilar surface colours
- Integrated barcode scanner and reader

Routine Mode and Gauge Mode – Automatic Data Saving



Routine Mode



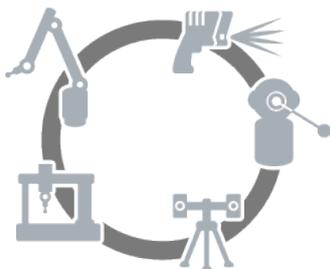
Gauge Mode

	LG7000	LG5000
Operating Use	Algorithm only or Algorithm and Routine modes	
Processor	1GHz ARM	
Memory	8GB of data/scans/routines	
Sample Rate	Up to 10 processed samples per second for many applications	
Display	800x480 / 256 colours, 7" display with touchscreen	320x240 / 256 colours
User Interface	2 multi-function buttons, 5-way joy stick	
Interface Port	USB 2.0 ports (2 Type A, 1 Mini-B) and 13pin circular DIN	USB 2.0 (1 Type A, 2 Mini-B)
Power Requirements	7.2VDC @ <2.5Amps	12VDC @ <2.5 amps
Power Supply	Lithium-ion (non-metal) rechargeable battery, 7.2VDC	Worldwide 60W A/C adapter (optional 12V rechargeable battery)
Environment	0° – 70°C	
PC Software Interface	LGWorks, Windows 10	LGWorks, Windows 10
Log File Output	User-defined, ASCII text format	
Size (WxHxL)	213x159x44mm	165x92x60mm
Weight	0.82kg without battery	0.45kg without battery
Housing	Cast urethane case with reinforced mounts. Nylon carrying case with shoulder strap.	

PolyWorks® 2022 Smart 3D Metrology Digital Ecosystem *NEW!*



Supports all your industrial manufacturing organization’s 3D measurement processes, from measurement planning by the design and manufacturing teams, to the measurement execution by the quality control team, and the enterprise-wide sharing of 3D measurement data and results.



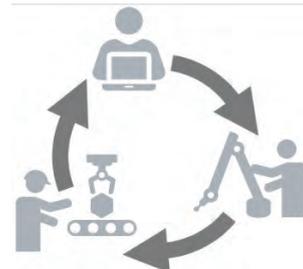
Universal Platform

Interface with all 3D measurement devices and perform all inspection tasks using one universal workflow.



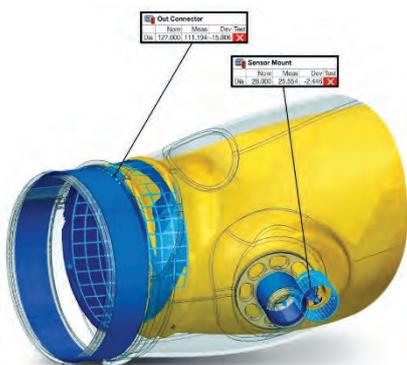
Digital Connectivity

Interconnect all of the people that capture or need access to 3D measurement information.



Collaborative Workflows

Facilitate digital collaborative teamwork at every stage of the product development process.



Accelerate feature extraction on a batch of highly deviated pieces



Create smart first-article inspection reports within Excel

PolyWorks|Inspector™ Dimensional Analysis and Quality Control



PolyWorks|Inspector™ is a universal 3D dimensional analysis and quality control software solution to control tool or part dimensions, diagnose and prevent manufacturing and assembly issues, guide assembly building through real-time measurements, and oversee the quality of assembled products by using portable metrology devices and CNC CMMs.

- Interface with all 3D measurement devices thanks to a universal digitizing hub
- Bring all relevant data under one roof through a universal data hub
- Perform all inspection tasks with or without CAD data using a universal 3D metrology workflow
- Deploy universal inspection projects playable on any 3D measurement device
- Complete Dimensional Analysis and Quality Control Toolbox, allowing users to extract meaningful information from their measured 3D data, automate the inspection process when more than one piece is measured, and structure the presentation of measurement results to facilitate enterprise-wide digital collaboration.

Market-leading Portable Metrology Platform

- Generate high-quality surface scans
- Ensure sufficient scanned data for reliable feature extraction
- Implement repeatable probing workflows
- Guide assembly building with real-time measurements
- Maximize the productivity of your scanning arms
- Leverage our disruptive laser tracker innovations
- Scan large structures rapidly using spherical digitizing
- Tailor measurement methods to your processes

High-productivity CNC CMM Solution



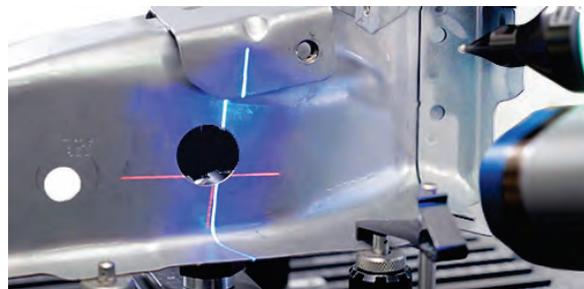
Reduce the complexity of CMM programming tasks



Accelerate the sequencing process while staying in control



Add measurement objects to a sequence effortlessly



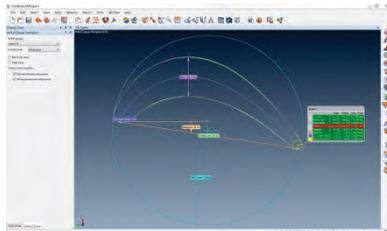
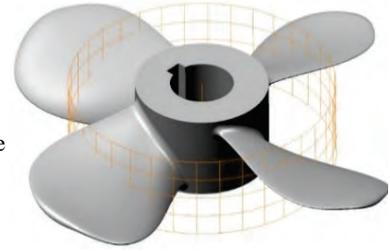
Complement CNC CMM projects with portable metrology data

Airfoil Gauge Module for PolyWorks|Inspector™

Comprehensive Dimensional Analysis of Fan, Compressor, and Turbine Blades

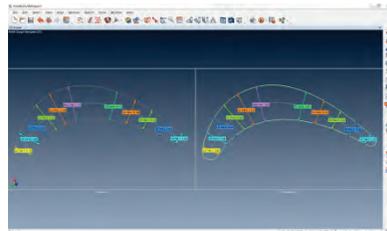


- Most robust camber line fitter in the industry
- Process datasets from any 3D measurement principle
- Flexible reverse engineering/adaptive manufacturing
- Extract key features and dimensions on a blade to create a model in your corporate CAD
- Fully customizable/programmable for specific needs



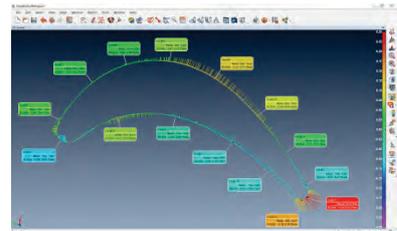
Geometric Primitives

- Camber line
- Leading edge point
- Trailing edge point
- Center of gravity
- Maximum thickness point
- Smallest enclosing circle
 - Tangent vector
- Leading edge tangent point
- Trailing edge tangent point



Dimensional Measurements

- Leading and trailing edge radii
 - Camber line length
 - Maximum thickness
 - Chord length
- Maximum width (aerodynamic / tangential)
 - Twist and stagger angles
 - Smallest enclosing circle
 - Inlet and exit angles
- Unlimited thickness measurements along camber line from leading or trailing edge points
- Distance between airfoils in a ring or blisk
 - Area



Data-to-CAD Deviations

- Leading edge point deviation
- Trailing edge point deviation
- Center of gravity deviation
- Maximum thickness point deviation
- Leading edge tangent point deviation
- Trailing edge tangent point deviation

PolyWorks|Inspector™ Probing Package

Universal 3D Metrology Platform for Single-Point Probing Devices



Operate all your probing devices from a common software platform. Supports arm-based, hand-held probing, digitizers, trackers and manual/CNC CMMs.

Multiple Device Positions automatic probed target matching, complete target analysis toolbox, temp compensation and large volume metrology bundle.

Universal workflow for performing all inspection tasks. Integrated Play Inspection measurement tool to automatically measure a new piece without teaching or scripting.



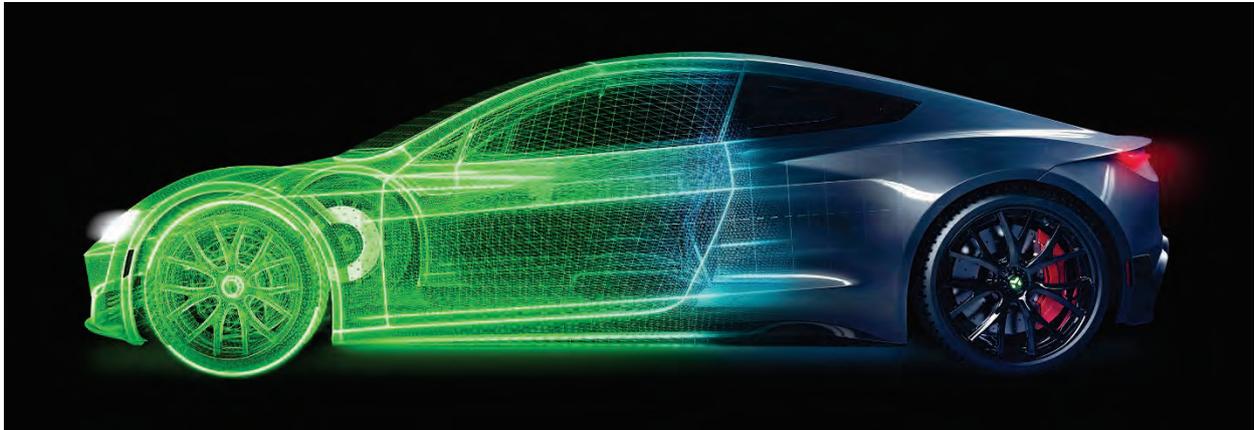
Repeatable operator-driven measurement workflows



Offers a complete toolset for large-volume metrology

PolyWorks|Modeler™ Point Cloud Reverse Engineering

True Interoperability between Digitized Polygonal Models and CAD/CAM Applications



PolyWorks|Modeler™ is a comprehensive reverse-engineering software solution that allows extracting optimal CAD entities—curves, surfaces, parametric sketches, and prismatic features—from polygonal models of digitized parts to serve as the starting point in your professional CAD modeling solution. Interface with all 3D measurement devices with a universal digitizing hub.



Polygonal Modeling



Surface Modeling



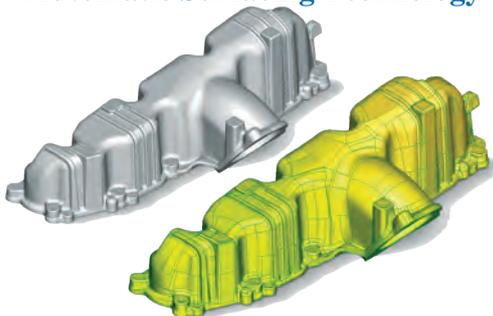
Solid Modeling

Create polygonal models of digitized parts in real time. Repair and optimize imperfectly digitized geometry. Apply CAD operations to polygonal models.

Create meaningful curves on polygonal surfaces. Create surface patches from curves automatically. Automate the creation of curves and surface patches.

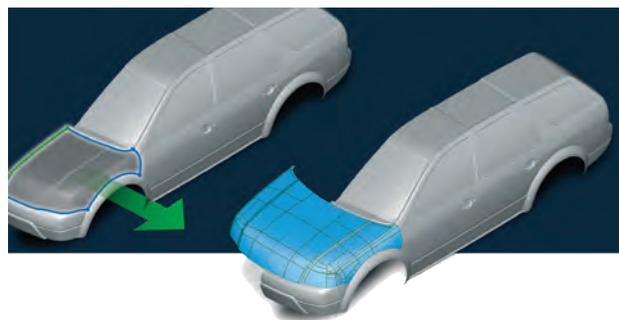
Create sketches from digitized models. Create sketch entities and dimensions. Transfer PolyWorks sketches to your CAD solution.

Get CAD-Friendly Surface Models from Automatic Surfacing Technology



With a single click, automatically turn your 3D scans into high-quality surface models directly usable in your preferred downstream applications, including FEA and mechanical simulation, machining, and CAD design, thanks to our revolutionary surface modelling approach.

Simplify your Reverse-Engineering Workflow



For even greater flexibility, the automatic surfacing technology is perfectly integrated within our intuitive curve-based surfacing workflow, letting you interactively edit the curve network to create optimal surface models.

PolyWorks 2022 Applications



Automotive



Aerospace



Consumer Products



Energy

PolyWorks 2022 Packages

PolyWorks|Inspector™ Packages

	Premium	Standard	Probing++	Probing	Gauging
Standard for all Packages	Measurement collection for digital gauges Manual measurement data entry and visual checks IGES/STEP neutral CAD file translator Part alignment toolset Dimensional control toolset Smart GD&T toolset Reporting toolset Simulation mode for offline project setup Repeatable multipiece measurement workflows Statistical Process Control toolset (SPC) One-year support/maintenance				
Single-point measuring device for portable metrology	√	√	√	√	
Single-point measuring device for CNC CMMs	√		√		
Point cloud digitizer for portable metrology	√	√			
Point cloud digitizer for CNC CMMs	√				
Real-time quality meshing and offline point cloud meshing	√	√			
PolyWorks Modeler™ Light module	√				
PolyWorks AR™ plug-in	√			Option	Option
Native CAD file translators	Option	Option	Option	Option	
Airfoil gauges	Option	Option	Option	Option	
Two complimentary seats for Basic classroom training	√	√	√	√	

PolyWorks|Modeler™ Packages

	Premium	Standard
Standard for all Packages	Point cloud digitizer for portable metrology Single-point measuring device for portable metrology Real-time quality meshing and offline point cloud meshing Polygonal editing Parametric sketching One-year support/maintenance Two complimentary seats to attend a Basic classroom training	
NURBS surfacing	√	

PolyWorks|ReportLoop™ Smart 3D Inspection Data Review

Digital Interoperability Solution for Reporting and Advanced Analysis



PolyWorks|ReportLoop™ is a free interoperability solution that allows you to inject smart 3D inspection data into Excel spreadsheets to complete your preformatted corporate reports or to analyze the performance of your 3D measurement processes.

Direct Access to Smart 3D Inspection Data

- Spreadsheets linked to dynamic 3D inspection data
- Automated spreadsheet updates
- Ideal for collaborative teamwork

Advanced Analyses at Your Fingertips

- Create reusable templates
- Leverage the power of Excel
- Analyze your measurement systems

PolyWorks|Talisman™ Smart Remote Control

Boosts Measurement Efficiency on the Shop Floor



The free PolyWorks|Talisman™ app is a smart remote control solution that allows measurement specialists to operate PolyWorks|Inspector™ from mobile computing devices, through a secure Wi-Fi connection. Work more efficiently by eliminating those back-and-forth trips to the computer. Just take your smart phone or tablet and your 3D measurement device to the parts to be inspected, and control your measurement session from beginning to end.

- Control PolyWorks® remotely
- Get live feedback anywhere
- Total confidentiality with encrypted communications



KinAiry Interim Field Check for Laser and Optical Trackers

How is Your Tracker Performing Right Now?

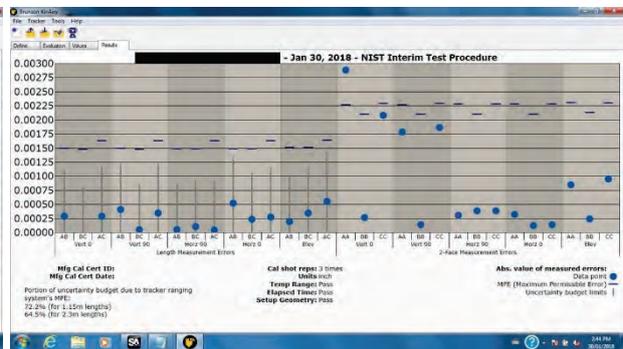
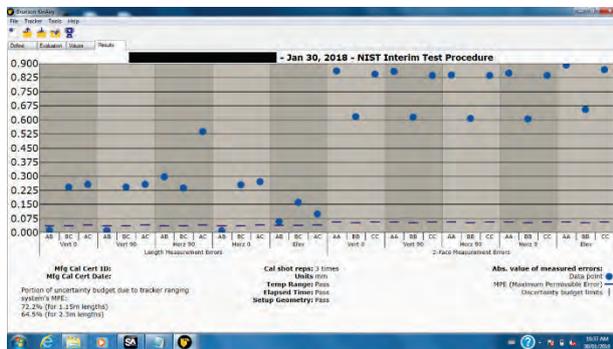


Why IR-8016?

- Evaluate Tracker before & after calibration
- Labor hours saved by reducing field errors via 30 minute NIST test on every tracker, every month?
- Rework hours saved by not having to retake incorrect measurements?
- Hours saved by producing monthly interim NIST tests, if failure is noticed in between calibration
- Best Practice Procedure to determine Cal cycle based on independent solution controlled by you!

KinAiry – before running compensation routine

KinAiry – AFTER running compensation routine



Example: Data values ran out on high side. To capture all data points, the scaling plot vertical axis is compressed, dropping the MPE line

Interim Field Testing of a Laser Tracker’s 3-D Length Measurement Capability based on B89.4.19

KinAiry is an independent laser tracker evaluation solution based on NIST’s Interim Field Test Procedure IR-8016. Comprehensive testing with measurement sets taken on a 2.3m calibrated scale bar used as a traceable reference artefact per B89.4.19 in strategic orientations located to fully exercise both the ranging and angular measurement components of a tracker. Volumetric performance results are presented in colour graphical analysis above, showing the overall health of your tracker.



- 1 Positioner
- 2 Mirror and Gimbal Mount
- 3 Software Flashdrive
- 4 Spanner Wrench
- 5 EasyConnect Base
- 6 Retroreflector Counterweights (2)
- 7 Position and Accessories Case
- 8 Length Artefact Case

KinAiry	
Artefact Length 2.43m	Artefact Rotation: 360° with 45° stops
Positioner / Length Artefact weight	11.2kg / 12.8kg
Packed Small Case / Long Case weight	21.2kg / 42.7kg

TetraLock™ Industrial Stand

Ultimate stability via pre-stressed tetrahedron structure with no possible joint movement when locked in open position.

Light 9.6kg. Check in as luggage, store in car trunk and use on tables/platforms. 119cm adjustable height via quick-action levers. Extend/retract each telescoping leg with handy index guide.

Cross-braces rotate down and “snap” in place for easy set-up.

TetraLock Lite provides the same ease of use and portability without the ultimate rigidity - only 7.3kg with 119cm max height. Deploys rapidly by tightening a locking plate under its mounting ring.



TetraLock

TetraLock Lite



EasyConnect™



Point Feet



Wheels



Laptop Shelf

M-Series Lightweight Portable Stands

Available in aluminium or graphite (lower weight and better thermal stability) double upper legs; with an adjustable instrument column or an adapter fixed directly to the tribrach at the top of the stand (increase lateral stability when fine vertical adjustment is not necessary). The stand height is adjustable by extending and locking the lower legs.

The M-series is also available in short or tall (longer double upper leg section and adjustable instrument column to provide the additional height) versions.

The lower legs are equipped with interchangeable trivet point or swivel pad feet (with thin, textured bottom rubber pad). The points work well on uneven surfaces; the pads on smooth or soft surfaces to resist sliding. Pads are outfitted with a hole for semi-permanent mounting.



M-Series Stand



Fixed Instrument Mount



Adjustable Height Collar



Trivet Point Feet



Swivel Pad Feet

231 Series Heavy Duty Stands **Short Mobile Stand**

The classic 231 series general use stand comes in 71cm to 107cm height configurations. A “hollow” version with unobstructed vertical path through the centre of the stand is available.

Use for Portable-CMMs, laser trackers, scanners and laser alignment devices, particularly when working with surface plates, machine tables, way checking and assembly operations. Stability is very well maintained. Drop-down casters are located under the heavy-duty tribrach base, engaged or released by a foot pedal for shop floor mobility. An air-check mechanism provides backup protection to prevent sudden drops of the instrument column in case the collar lock and main handle are released simultaneously while disengaging the ratchet pawl.



STASIS **Scanning Instrument Positioner**

STASIS is the only gimbal-style instrument mount that allows you to directly reposition your scanner point-to-point, adjusting the roll, pitch and yaw of your shot, within a 10ft horizontal range and a maximum 8ft height.

Typical industry stands require mounting your scanner in a fixed position. With STASIS, you could have already taken at least three shots within the same time, without moving the base!



Max Instrument Weight	15.5kg
Horizontal Reach	3,048mm
Max Height	2,438mm
Min Height	356mm
Axes of Movement	6 rotations / Base (azimuth) – 360° / Hand (roll, pitch, yaw) – 360°
Weight excluding Base	45kg

Thermally Stable Invar Scale Bars

Invar material provides a thermally stable reference length during laser tracker or scanner jobs. A low thermal expansion (LTE) scale bar is also available as an option.



1.5LRB Length Reference Bar for laser tracker or scanner jobs. NIST-traceable certification to $\pm 0.003\text{mm}$; length of bar within $\pm 0.79\text{mm}$ of length. Max Length: 2.3m



1.5LTE-1000MM low thermal expansion Length Reference Bar. Length within 1.5mm of 1 meter with expanded uncertainty of $\pm 0.007\text{mm}$ at 95% confidence interval

Target Holder Kits

Laser tracker target holder kits fitting 0.5” and 1.5” reflectors to measure the position of holes, edges, corners, surfaces, diameters, etc. Made of hardened stainless steel, certified and serialized. In English (THK-CE) and Metric (THK-CM) units.

Approx. weight of Case and contents: 3.2kg; Case: Foam-lined, injection molded, waterproof.



THK-.5E or THK-.5M for 0.5” Reflectors



THK-1.5E or THK-1.5M for 1.5” Reflectors

In-Line Check Weighing



Anritsu KWS6412BF12 High Accuracy Checkweigher



Anritsu KW9314AW3G Side-Belt Checkweigher

In-Line X-Ray Inspection



Anritsu KXE7534AWHZE Dual Energy Sensor Technology



Anritsu KXE7514BWELE Side-View X-Ray Inspection

In-Line Metal Detection



Anritsu M6 Series Metal Detector for metal contaminants



Anritsu M6-h Large Metal Detector

Advanced and Precision Metrology



Waygate Technologies V|tome|x M 3D X-Ray CT for Analysis and Metrology



Bruker Alicona InfiniteFocus G6 3D Form & Surface Measurement



Accretech Surfcom NEX 2-in-1 Roughness/Contour Tester



Accretech XYZAX AXCEL CMM



Accretech Rondcom NEX Roundness Measuring Machine



Nikon NEXIV VMZ-S Series CNC Video Measuring System

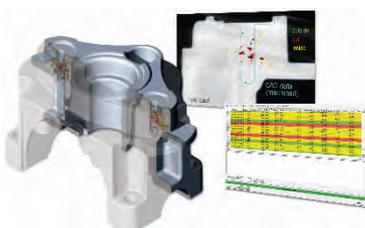


Starrett AVX550 CNC Automatic Vision Metrology System

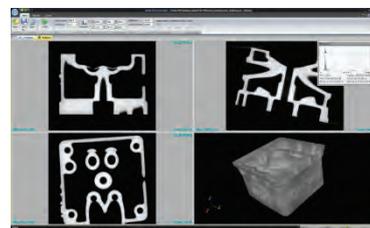


OSK CLP -35DDSF Gear Tester

Software Solutions



Volume Graphics VGStudio



Phoenix datos|x

Pre- and Post-Sales Support includes: -

- Software Applications & Measuring Related Services
- Preventive Maintenance and Repairs
- Retrofits and Upgrades of Pre-Owned Machines
- Performance Verification and Calibration

ISO/IEC 17025 CALIBRATION LABORATORY ACCREDITATION

We are certified to ISO/IEC 17025:2005 Laboratory Accreditation in Singapore, Malaysia, Thailand and Philippines by SAC-Singlas and in Indonesia by Komite Akreditasi Nasional for the calibration in general of CMMs (contact and non-contact), Surface Roughness, Contour and Roundness Testers, Profile Projectors and Universal Length Microscopes.

Our calibration labs in Thailand, Philippines and Indonesia are also accredited for Portable Coordinate Measuring Machines complying with B89 standard, and ISO10360-12 standard for the latest model. We are also accredited for the calibration of Checkweighing systems in Singapore, Malaysia and Indonesia.



OUR MANAGEMENT COMMITMENT

Our **Vision** is to be your trusted metrology solutions partner of choice via our **Mission** to support your quality quests with appropriate metrology solutions and competent pre- and post-sales technical support throughout the solutions' useful lives.



Our Group Managers, Malaysia, November 2019

The International System of Units (SI)

Length – metre (m): the path length travelled by light in vacuum during a time interval of $1/299792458$ of a second; commonly realised through the wavelength of the 633nm radiation from a helium-neon laser stabilised against a spectral line of iodine molecules, based on the formula $\lambda o = c/v$ where c is the speed of light in vacuum defined at 299792458 m/s and v is the measured frequency of the radiation used.

Mass – kilogram (kg): the unit of mass, equal to the international prototype of the kilogram, made of platinum-iridium and kept at the International Bureau of Weights and Measures (BIPM) in Paris. International standardisation is carried out using precision comparators, combinations and sub-multiples of the 1kg masses of similar materials.

Time – seconds (s): the duration of 9192631770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom; realized using caesium atomic clocks, where quantized caesium energy levels provide a source of resonance frequency, which is then phase-locked to a quartz oscillator to produce a very precise frequency (with a good long-term stability) to define the second.

Thermodynamic temperature – Kelvin (K): the unit of thermodynamic temperature (symbol T), is the fraction of $1/273.16$ of the thermodynamic temperature of the triple point of water. T at 273.16 K, also defined as 0.01°C in Celsius temperature (symbol t), is realised by the use of the water triple point cells, from which other temperatures are related through the International Temperature Scale of 1990 (ITS-90).

Electric current – ampere (A): that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} Newton per metre of length; realised through the *volt* and the *ohm* representations determined using the Josephson effects of super-conductivity and the quantised Hall resistance (von Klitzing constant) respectively.

Amount of substance – mole (mol): the amount of substance which contains as many elementary entities as there are atoms in 0.012kg of carbon 12. The elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles. The mole is most accurately realised through the determination of the Avogadro Constant by primary methods such as isotope dilution mass spectrometry.

Luminous intensity – candela (cd): the luminous intensity in a given direction of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and has a radiant intensity in that direction of $1/683$ watt per steradian; realised using a cryogenic radiometer that measures optical radiant power based on the thermo-equivalence of the heating effect of optical radiant power with that of electrical power. A solid-state photometer with a relative spectral responsivity simulating the spectral efficiency function $V(\lambda)$ of the human eye, calibrated directly against the cryogenic radiometer, is used to evaluate light of other frequencies in the visible spectral region.

20 May 2019 Redefinition of the SI Units

From 20 May 2019, the SI units will be revised in terms of 7 defining constants that describe the natural world:

Base Unit	Defining Constant		Constant Values	Unit
Kilogram kg	Planck Constant	h	$6.62607015 \times 10^{-34}$	J s
Meter m	Speed of Light in Vacuum	c	299 792 458	m/s
Seconds s	Unperturbed ground state hyperfine transition freq. of Cs133 atoms	$\Delta\nu_{\text{Cs}}$	9 919 263 177 0	Hz
Ampere A	Elementary Charge	e	$1.602176634 \times 10^{-19}$	C
Kelvin K	Boltzmann Constant	K	1.380649×10^{-23}	J/K
Mole mol	Avogadro Constant	N^{A}	$6.02214076 \times 10^{23}$	mol^{-1}
Candela cd	Luminous efficacy of monochromatic radiation of freq. 540×10^{12} Hz	K_{cd}	683	lm/W

The SI base units will then be derived from the defining constants or from 22 important derived units derived from the constants and maintained for consistency per the ISO/IEC 80000 International System of Quantities (ISQ).

The highest-level experimental methods used for the realization of units by the equations of physics are now known as primary methods. The new definitions allow freedom to choose equations of physics for the realization with the defined constants of unit quantities to be measured for limitless improvements in measurement accuracies.