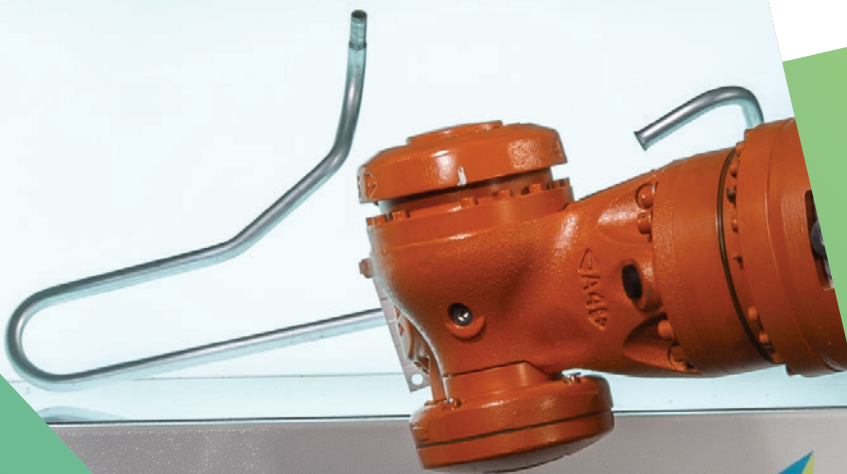


Tube and wire inspection solutions

Metrology for the tube and wire production industry



TUBEINSPECT





Tube and wire measurement

Any shape, any size, anywhere

Hexagon's comprehensive range of tube and wire measurement systems delivers solutions tailored to a variety of applications in the world of tube production. They combine high-precision hardware engineering with innovative and intuitive software platforms to fully meet the demands of inspection, manufacturing, gauging and reverse engineering processes, whether manual or automated. The result is a product portfolio tailored to support cost-effective production and meet the challenges of every application in the tube and wire manufacturing sector.

Our range

- **TubeInspect**
High-accuracy high-speed tube measurement.
- **Absolute Arm with BendingStudio**
Portable manual measurement of complex tubes with a laser scanner.
- **Absolute Arm with TubeShaper**
Portable manual measurement of tubes with infrared probe.

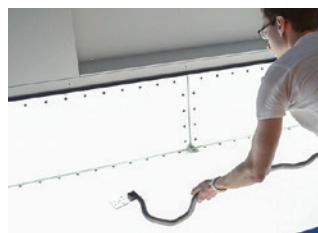


TubeInspect

TubeInspect is the leading solution for high-speed tube measurement. Based on a multiple-camera optical scanning system built into a turnkey single-piece cell format, TubeInspect represents the height of what's possible with optical scanning in the tube and wire production industry.

Powered by the dedicated BendingStudio software platform, TubeInspect is available in both an industrial-sized TubeInspect P16.2 and a smaller TubeInspect P8.2 variant. Both models are also available in HRC high-resolution camera versions delivering improved detail and feature analysis. High-end models also offer the possibility of integration within a larger robotic production cell, making the tube and wire quality process fully Industry 4.0 compatible.

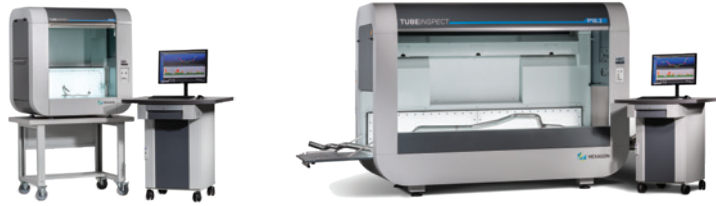
The system's integrated long-life and low-maintenance LED illumination technology guarantees smooth illumination of the measuring field, automatically controlled through BendingStudio. Imaging is fast and detailed with GigE camera technology that ensures synchronic capture of the measuring object within milliseconds. And all this is built on an innovative three-dimensional glass reference surface that is highly precise and offers the reliable stability demanded for shop floor use.



TubeInspect

A turnkey solution for instant high-end tube measurement.

- Enclosed concept suitable for rough production environments.
- Measurement within seconds after placing tube into the measurement system.
- Stable construction delivers highly reproducible and user-independent results.
- Applicable for serial inspection of high-volume batches and for reverse engineering and prototyping.
- Measure flexible, malleable or freeform bent tubes.
- High-end HRC models for more detailed inspection and automation capability.
- Can be fully integrated within a larger robot manufacturing cell.
- Position and orientation measurement of end holders, fittings and fixtures through high-resolution image analysis with CAD-adaptors.
- Hotkey button on front panel for beginning and confirming measurements.
- Quick return on investment due to less waste and higher bender availability.



Solutions specifications

	P8.2	P8.2 HRC	P16.2	P16.2 HRC
Measurement technology	High-resolution camera array			
Software	BendingStudio			
Measurable tube diameter	2-125 mm	0.8-125 mm	3-200 mm	1.5-200 mm
Measuring volume	1000 x 580 x 400 mm		2600 x 1250 x 700 mm	
Max. tube length	Unlimited (with repositioning)			
Bending angle	1-340°			
Min. push between bends	Bend-in-bend and freeform possible			
Measurement accuracy (tube sheath deviation)	0.035 mm (1σ)		0.085 mm (1σ)	
CAD-adaptors	no	yes	no	yes
Rectangle-section tube measurement	no			
Automation compatibility	no	yes	no	yes

System specifications

	P8.2	P8.2 HRC	P16.2	P16.2 HRC
Measurement speed	> 3 sec/measurement			
Camera array	8 high-resolution digital cameras with GigE technology		16 high-resolution digital cameras with GigE technology	
Resolution	3 MP	12 MP	3 MP	12 MP
Reference field	Three-dimensional glass reference surface			
System dimensions (W x D x H)	1140 mm x 746 mm x 1140 mm		2980 mm x 1640 mm x 2300 mm	
Weight	240 kg		1200 kg	
Power requirement	100-240 V 50-60 Hz AC 400 VA		100-240 V 50-60 Hz AC 1300 VA	
Working temperature	5-40°C			
Relative humidity	10-90% not condensing			
Marks of conformity	CE			

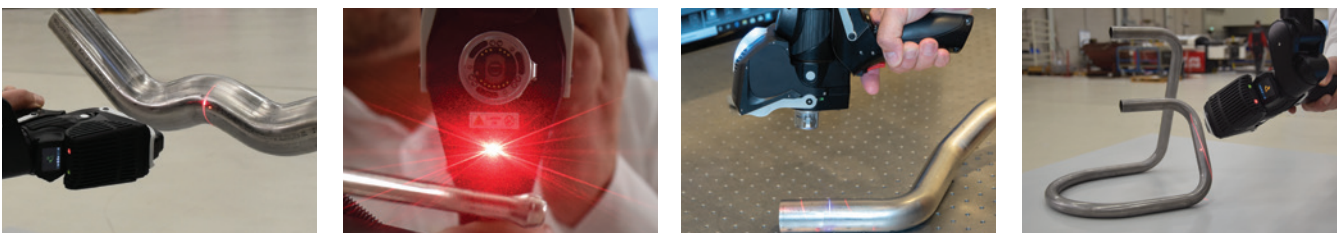


Absolute Arm with BendingStudio

Combining the established laser scanning technology of the Absolute Arm range with the leading tube and wire analysis capabilities of BendingStudio, the Absolute Arm with BendingStudio solution is the perfect portable complement to the TubeInspect series.

When working from the same innovative software platform as TubeInspect, the Absolute Arm can deliver high-speed manual collection of high-accuracy scan data of any tube or wire. Leveraging the leading measurement technology of Hexagon's flagship portable measuring arm compatible laser scanners, full non-contact measurement and geometry definition is quickly achievable with no need for special clamping or alignment procedures, even on shiny surfaces.

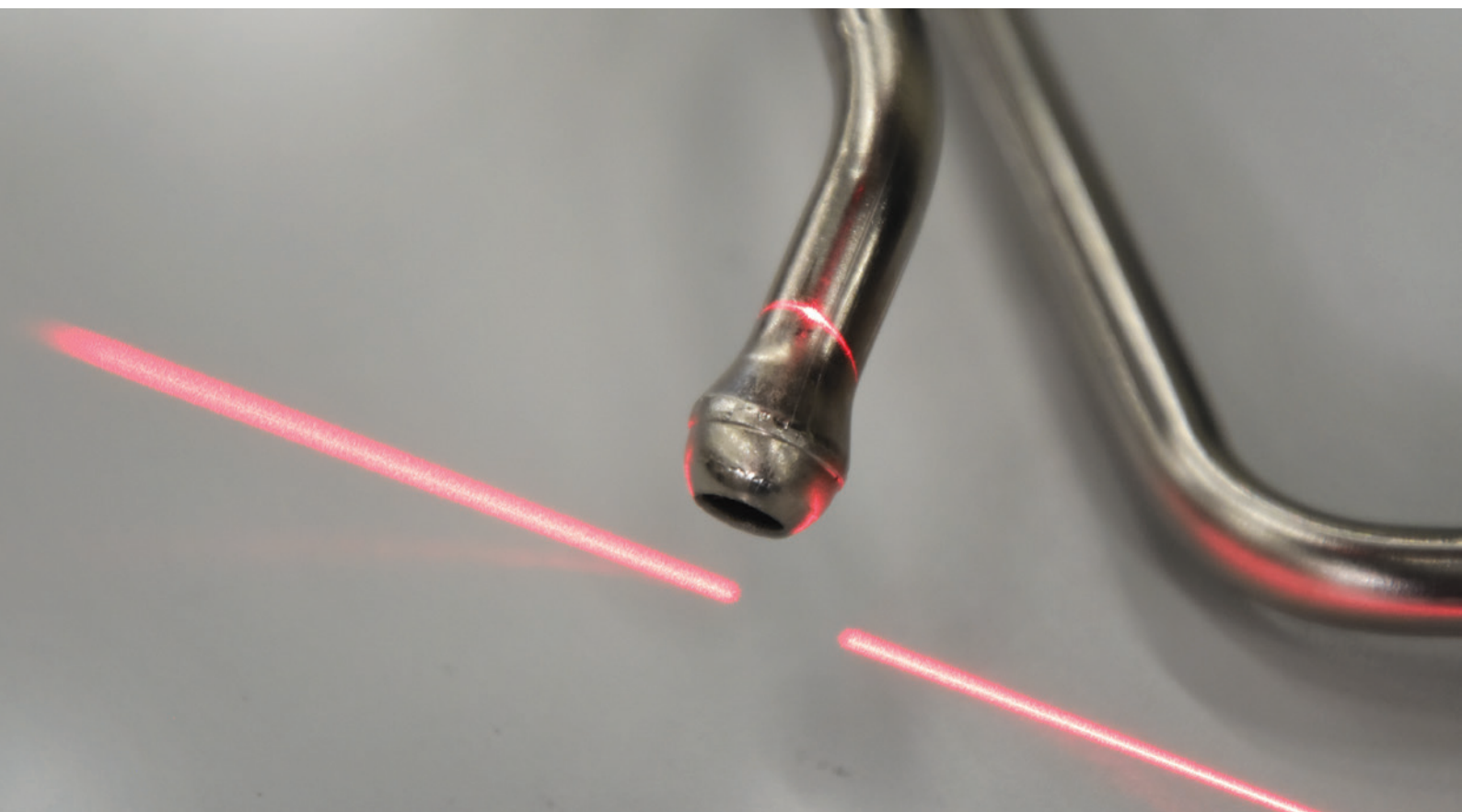
Flexible or rigid, freeform or angular, at the bending machine or in the centre of the production process; BendingStudio with Absolute Arm is a highly adaptable solution for high-quality tube and wire measurement.



Absolute Arm with BendingStudio

Unrivalled portable tube and wire analysis through laser scanning.

- Fully functional high-end portable measuring arm with laser scanner has the versatility for tube analysis as well as other measuring tasks.
- Collect accurate tube and wire geometry data without scanning the entire tube surface or using complex fixturing.
- Measure flexible, malleable tubes of any length and of diameter up to 300 millimetres.
- Accurate scanning on tubes of a wide variety of materials, colours and surfaces.
- Position and orientation measurement of end holders, fittings and fixtures through scanner point cloud analysis with CAD-adaptors.
- Highly portable system suitable for tube and wire measurement in any place needed.
- Repeatable, user-independent measurement results.
- High-definition scanning delivers incredibly fast determination of full tube and wire geometries.
- Easy measurement of parts in hard to reach areas.
- 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.

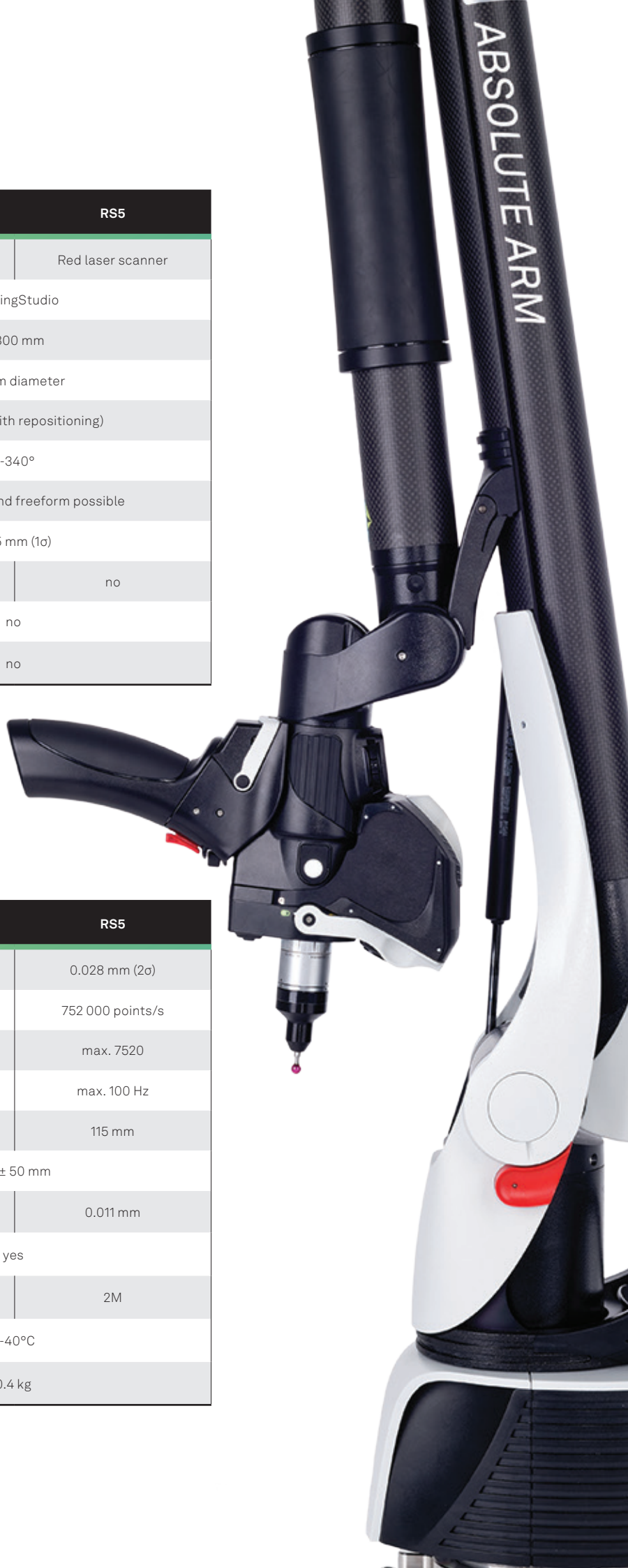


Solution specifications

	RS6	RS5
Measurement technology	Blue laser scanner	Red laser scanner
Software	BendingStudio	
Measurable tube diameter	3-300 mm	
Measuring volume	2-4.5 m diameter	
Max. tube length	Unlimited (with repositioning)	
Bending angle	1-340°	
Min. push between bends	Bend-in-bend and freeform possible	
Measurement accuracy (tube sheath deviation)	0.05 mm (1 σ)	
CAD-adaptors	yes	no
Rectangle-section tube measurement	no	
Automation compatibility	no	

Laser scanner specifications

	RS6	RS5
Accuracy	0.026 mm (2 σ)	0.028 mm (2 σ)
Point acquisition rate	up to 1.2 million points/s	752 000 points/s
Points per frame	max. 4000	max. 7520
Frame rate	max. 300 Hz	max. 100 Hz
Line width (mid)	150 mm	115 mm
Standoff	165 \pm 50 mm	
Minimum point spacing	0.027 mm	0.011 mm
System scanning certification	yes	
Laser class	2	2M
Operating temperature	5-40°C	
Weight	0.4 kg	



BendingStudio

The BendingStudio software platform links all data and processes related to the production of bent parts, from design and process planning to manufacturing and quality control. BendingStudio is the only tool to meet and combine these requirements with an emphasis on metrological processes.

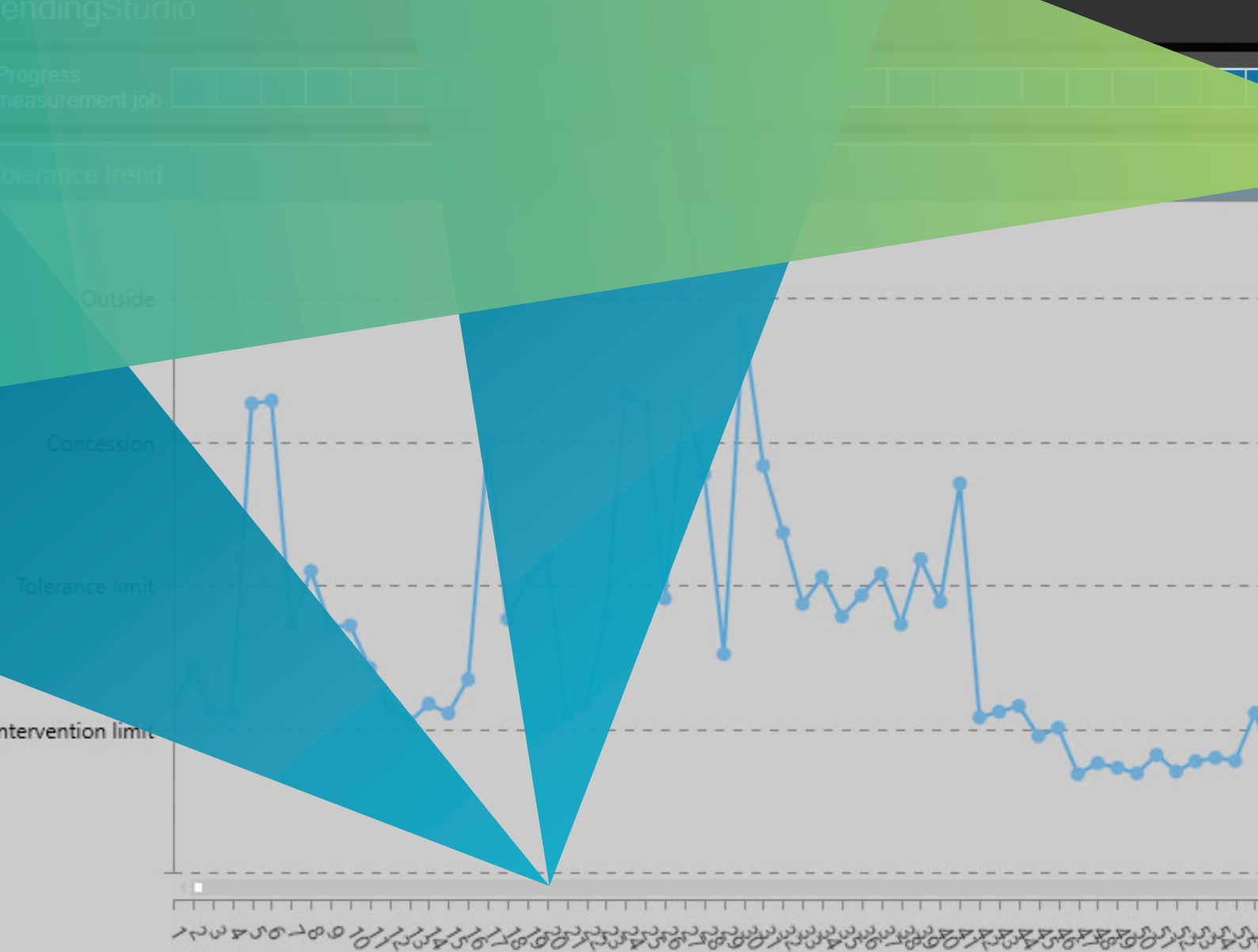
Evaluate parts quickly with clear actual-nominal value comparison. Implement multiple inspection plans with individual measurement criteria for each part. Enjoy comparable result presentation no matter the origin of the data. BendingStudio is the complete package for complex analysis and management of tube and wire production.



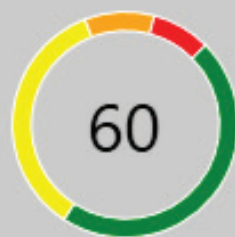
The complete solution for managing bending production and quality control, end-to-end.

- Optimised communication and data handling across production, quality control and design offices.
- Complete cross-compatibility between TubelInspect and Absolute Arm systems for measurement inputs.
- One-click functionality for measurement results, data import and export.
- Simple and clearly structured handling concept, including interfaces for statistical process control software such as qs-STAT.
- Wide range of measurement functions such as bending points, bend data, sheath deviation and diameter changes, as well as measurement of branched tubes and bevel-cut ends.
- Optimise series inspection of parts and improve process reliability with measurement jobs.
- Open tube bender interface for calculation and communication of production correction data.
- Assign different inspection plans to single a part – display drawing requirements and mounting conditions from the same measurement.
- Automatic correction of self-weight deformation effects in thin or elastic workpieces.
- Position and orientation measurement of end holders, fittings and fixtures through scanner point cloud analysis with CAD-adaptors.





Result value distribution



- Evaluation failed
- Within intervention limit
- Within tolerance limit
- Within concession limit
- Out of limits

Repetition 56



Repetition 57



Repetition 58



Repetition 59



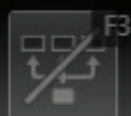
Overview



Details



Release part



Deactivate



Inspect



Continue



Create

BendingStudio packages

		Efficient	Tube	Tube +	Wire	Professional	Automatic
Measurement systems	<ul style="list-style-type: none"> • TubeInspect P8.2, P16.2 and Absolute Arm with RS5 Laser Scanner • TubeInspect P8.2 HRC and P16.2 HRC • Absolute Arm with RS6 Laser Scanner 	■ ■ ■	■ ■ ■	□ ■ ■	■ ■ ■	■ ■ ■	□ ■ □
Basic functions	Part database; user management; measurement of tubes and wires; calculation of bending data (LRA/PBR, XYZ); nominal-to-actual comparison; sheath tolerance inspection (optical gauge); reverse engineering; reports; interface to qs-Stat®.	■	■	■	■	■	■
Advanced functions	Inspection criteria for functional dimensions; deflection compensation for long, thin or elastic tubes; rotationally symmetric formed tube ends; bevel cut ends; diameter changes.	□	■	■	■	■	■
CAD-adaptors	Position and orientation measurement of end holders, fittings and fixtures without mechanical adaptor.	□	□	■	□	■	■
TubeInspect adaptors	Straight-on and elbow adaptors; TubeInspect adaptors.	□	■	■	□	■	□
Branched tubes	Measurement of branched tubes.	□	□	□	□	■	■
Hoses	Straightening of hose components.	□	□	□	□	■	□
Bender interface standard	Calculation of bending correction data; virtual gauge simulation tool; open bender interface. Note: uploading of correction data must be enabled on the bender.	■	■	■	■	■	■
Bender interface freeform	Calculation of bending correction data including bending radii; virtual gauge simulation tool; open bender interface. Note: uploading of correction data must be enabled on the bender.	□	□	□	■	■	□
Automation	Integration in automated manufacturing cell including remote control of relevant BendingStudio functionalities by third-party controller based on XML interface.	□	□	□	□	□	■
CAD-WIZARD	Import/export of IGES and STEP files; import by automatic or interactive selection of bending data; export of tube geometry in IGES and STEP format.	○	○	■	○	■	■
Offline	Offline licence with same functionalities/modules as main licences but without interface to measurement system. Also available as network licence.	○	○	○	○	○	○

All BendingStudio packages include a 12-month SMA

■ included □ not included ○ option

BendingStudio specifications

BendingStudio	
CAD model import formats	IGES, STEP
CAD export formats	IGES, STEP
Data import	CSV, FIF, GTT (G-Tube), SV, VDA, XML and other ASCII formats
Data export	CSV, FIF, SV and other ASCII formats
Measurement report export	XPS (PDF equivalent), DFQ (qs-Stat)
Available languages	English, Chinese (Simplified), Czech, Dutch, French, German, Italian, Japanese, Polish, Portuguese, Romanian, Russian, Spanish, Swedish, Turkish



Absolute Arm with TubeShaper

The Absolute Arm with TubeShaper system is a completely integrated hardware and software solution for the measurement of tubes, pipes, wires and hoses. Combining the non-contact measurement capabilities of the Absolute Arm portable coordinate measuring machine and the purpose-built tube measurement software TubeShaper, the system offers total measurement versatility.

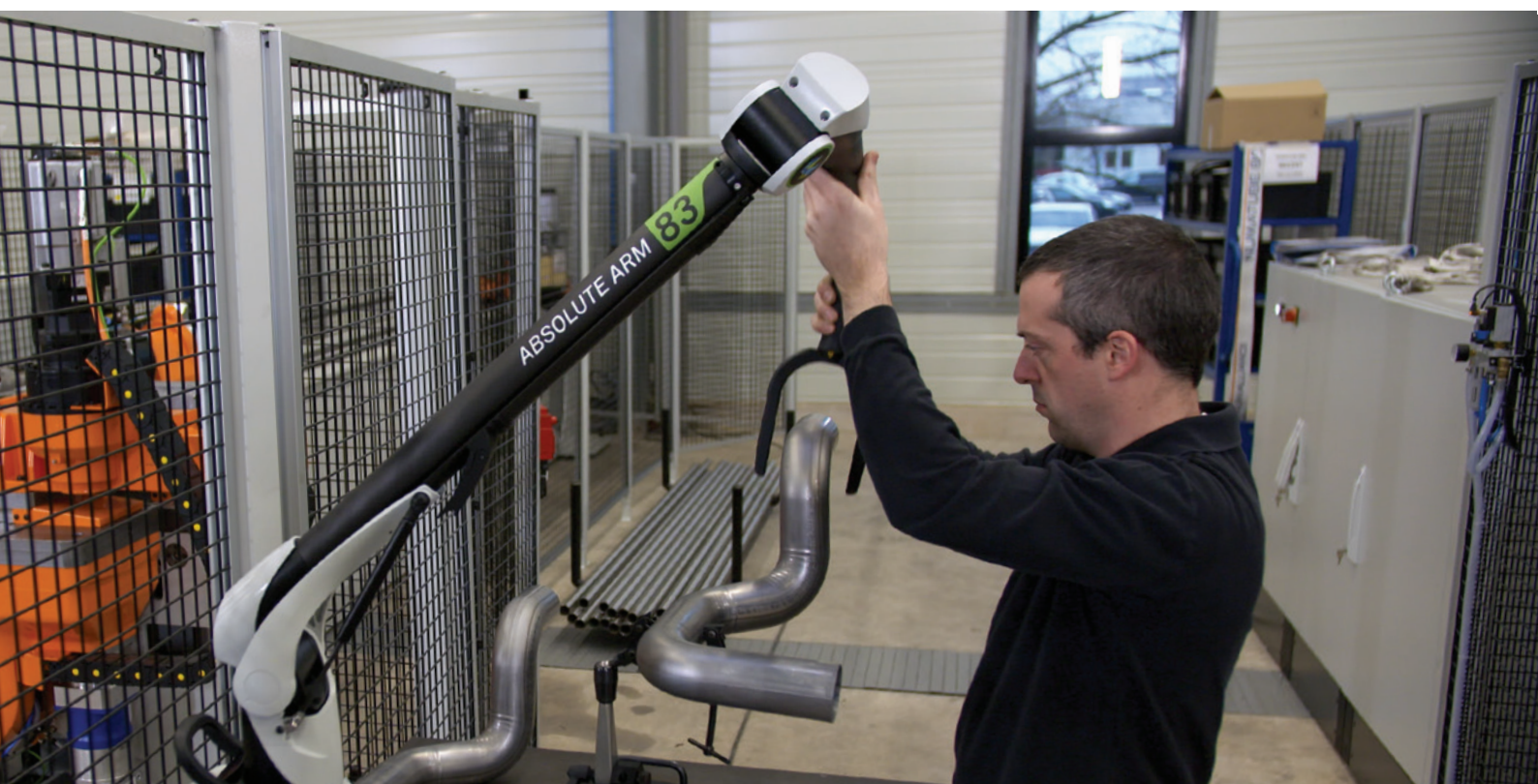
Tubes can be checked throughout the entire manufacturing process in one simple and highly portable package. The system is based on a strengthened arm structure and an infrared non-contact probe custom-designed for tube measurement. From ensuring accurate bending form to checking the position of welded accessories like flanges, brackets or hangers, the Absolute Arm with TubeShaper system makes it easier than ever to spot problems on the shop floor, saving time and reducing waste.



Absolute Arm with TubeShaper

Complete portable tube and fixture analysis through touch and infrared probing

- Non-contact infrared tube probes enable the inspection of almost any tube material, including malleable surfaces.
- Six tube probes available for tube diameters from 4 to 130 millimetres, while larger diameters can be measured with a touch probe, supplied as standard with every Absolute Arm.
- Measure geometric features like flanges, brackets and hangers or certify Go/No-Go fixtures.
- Automatic probe recognition and repeatable mounting allows probes to be swapped without recalibration
- Seamless compatibility with the leading TubeShaper software platform for measurement and bender correction.
- Tube probing functionality compatible with every standard Absolute Arm model, as well as dedicated tube models available in 2.5- or 3-metre measurement volumes.
- Absolute Arm tube models have a stronger counterbalance for improved ergonomics, faster measurements and reduced operator fatigue.
- Easy-to-use arm requires no warm-up or encoder referencing – simply switch on and measure.
- Full WiFi and hot-swappable battery-powered functionality for increased portability.
- Complete range of accessories includes additional probes, tube clamps, measurement tables and raisers to suit the working environment.



Solutions specifications

Absolute Arm	
Measurement technology	Infrared tube probe (for tube measurement) Touch probe (for feature measurement)
Software	TubeShaper
Measurable tube diameter	4-130 mm (larger using touch probe)
Measuring volume	1.2-4.5 m diameter
Max tube length	Unlimited (with repositioning)
Bending angle	3-180°
Min. push between bends	n/a
Measurement accuracy	E_{UNI} accuracy of arm (to ISO 10360-12) + 0.1 mm
CAD-adaptors	no
Rectangle-section tube measurement	yes
Automation compatibility	no



Tube probe specifications

Tube probe size 1	Tube probe size 2	Tube probe size 3	Tube probe size 4	Tube probe size 5	Tube probe size 6
Tube diameters of 4 - 13 mm	Tube diameters of 10 - 20 mm	Tube diameters of 16 - 40 mm	Tube diameters of 30 - 65 mm	Tube diameters of 50 - 85 mm	Tube diameters of 70 - 130 mm

Absolute Arm Tube Model accuracy and size specifications

Model	E_{UNI}^1	P_{SIZE}^2	L_{DIA}^3	P_{FORM}^4	Weight ⁵	Max. reach
8325T	0.058 mm	0.025 mm	0.066 mm	0.048 mm	8.1 kg	2.73 m
8330T	0.083 mm	0.036 mm	0.089 mm	0.068 mm	8.4 kg	3.23 m

¹ E_{UNI} Maximum permissible longitudinal error of measurement – according to ISO 10360-12:2016

² P_{SIZE} Maximum permissible probe deviation, size – according to ISO 10360-12:2016

³ L_{DIA} Maximum permissible probe deviation, position – according to ISO 10360-12:2016

⁴ P_{FORM} Maximum permissible probe deviation, shape – according to ISO 10360-12:2016

⁵Weight Weight without probe

TubeShaper

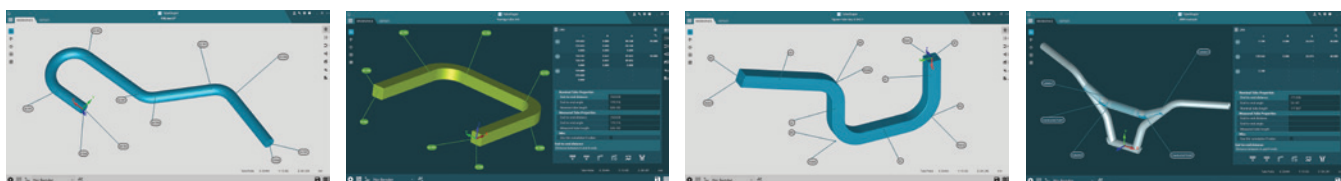
TubeShaper combines the best cutting-edge technology to create a highly advanced yet totally intuitive software proposition. Designed to maximise efficiency and reduce waste, TubeShaper can connect directly to CNC tube bending machines, automatically create measurement plans and import CAD models, all within a user-friendly package.

With a state-of-the-art user interface, TubeShaper goes beyond bending to cover every important application within tube manufacturing. Inclusion of a touch probe for data input as standard powers innovative design processes for both tubes and fixturing, as well as allowing for complete analysis of vital features such as flanges, brackets and hangers.



Full quality and control functionality across every tube-related application.

- Supports touch-probe measurement as standard, for measuring welded brackets and flanges.
- Real-time CNC bending machine connection allows measurement corrections to be implemented easily, minimising waste and increasing process efficiency.
- Easy creation of spring-back and elongation library, to be stored and applied to any tube later.
- Tube geometry (LRA / YBD data) automatically extracted from any imported CAD model.
- Dual-profile graphical user interface with touchscreen compatibility streamlines training as users learn only what they need.
- Measurement plans can be created automatically at first-part inspection or set up offline to minimise downtime and support high-speed batch measurement.
- Supports in-bend measurement for improved accuracy when measuring deep and shallow bends.
- Handling of rectangle-section tubes with standard non-contact tube probes, including reverse engineering and bending machine correction functionality..
- Define tubes through keying in LRA (YBD) or xyz values, CAD model import, reverse engineering or sketch function.
- Offline software licences deliver complete software functionality without cost of connecting to a measurement device or bender, perfect for departments with multiple users sharing measurement plans and results across locations.



TubeShaper specifications

TubeShaper	
CAD model import formats	IGES, STEP, VDA, PAR, PRT, CAT, DXF, X_T, CAD, ASM and IAM
CAD export formats	Tubes and features can be exported as IGES
Data import	SV, GTT (G-Tube), ds (DOCS)
Data export	IGES, SV
Measurement report export	PDF, CSV
Available languages	English, Chinese (Simplified), Dutch, French, German, Italian, Japanese, Korean, Polish, Portuguese, Russian, Spanish, Turkish

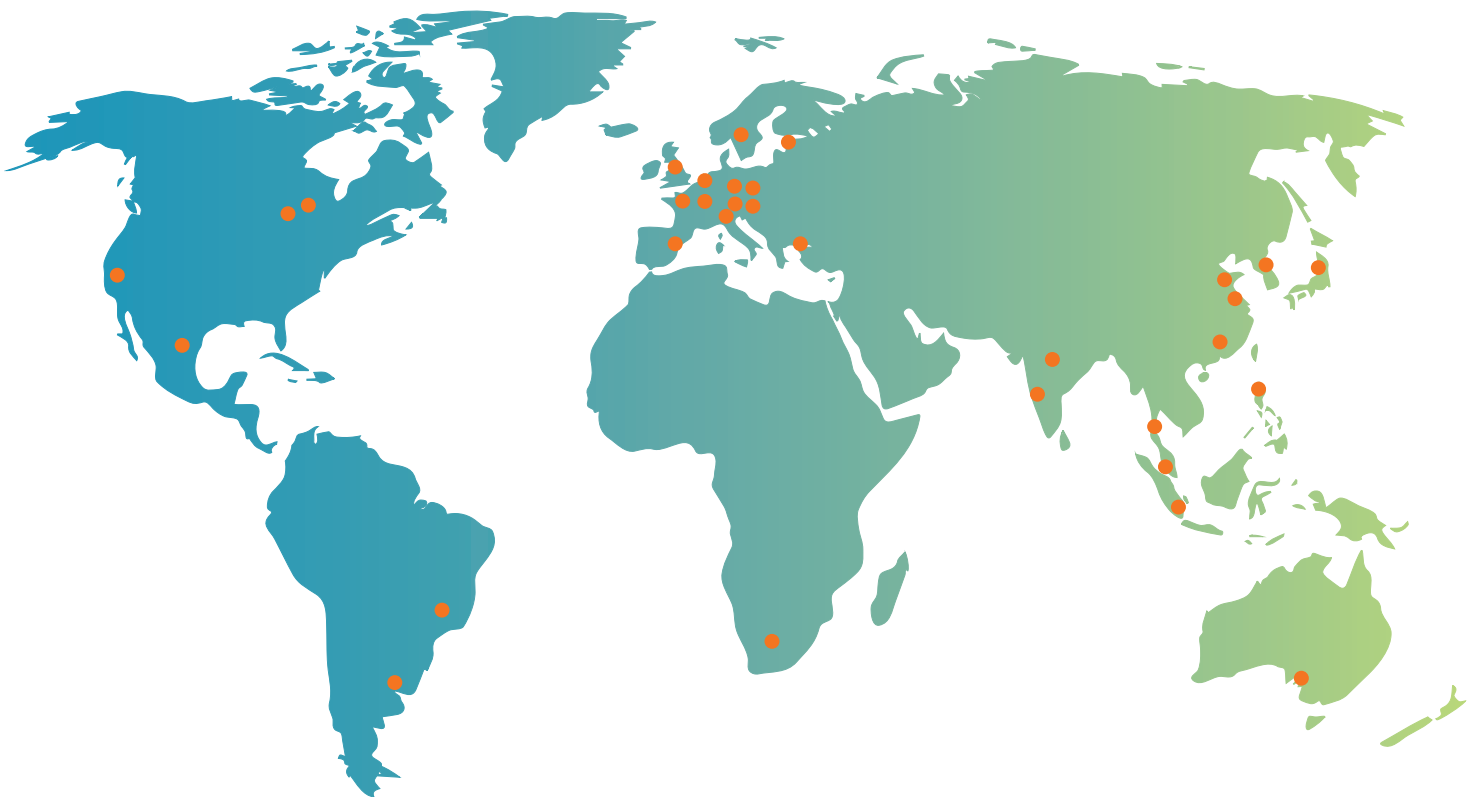
World-class products to rely on

Drawing on decades of research and development experience, technology from Hexagon's Manufacturing Intelligence division is built on a long history of outperforming technological innovation. Deriving quality from experience to drive productivity is what keeps Hexagon in front and able to deliver first-class solutions for industries around the world.

Along with the assurance of ten years of serviceability, owners of tube and wire solutions from Hexagon benefit from a 24-month factory warranty as standard – our guarantee that our technology will always meet the needs of our users.

World-class support delivered locally

The international presence of Hexagon guarantees comprehensive aftersales support and services across the globe. With the largest dedicated service team of any metrology equipment manufacturer and an emphasis on locally delivered solutions, Hexagon is unmatched from service, repair, certification and calibration through operator training and software maintenance and upgrades.



World-class service made simple

Customer Care Packages

Owners of tube and wire solutions from Hexagon have the opportunity to invest in a Customer Care Package - a standardised after-sale service package designed to ensure equipment remains in top condition and can be relied upon for accurate measurement results.

- Maintenance and warranty plans that ensure top equipment availability
- Trouble-free usage and minimal downtime.
- Preferred hotline access at no additional cost
- Access to professional advice whenever it's needed

Customer Care Packages include a selection of the following benefits, depending on the tier chosen.

- Planned annual service
- Hardware support
- Annual maintenance and recertification
- Remote assistance
- Repair parts and labour
- Customised local benefits
- Software maintenance

For complete details of the benefits of each level of Customer Care Package, please contact a local Hexagon representative.



Hexagon is a global leader in sensor, software and autonomous solutions. We are putting data to work to boost efficiency, productivity, and quality across industrial, manufacturing, infrastructure, safety, and mobility applications.

Our technologies are shaping urban and production ecosystems to become increasingly connected and autonomous – ensuring a scalable, sustainable future.

Hexagon's Manufacturing Intelligence division provides solutions that utilise data from design and engineering, production and metrology to make manufacturing smarter. For more information, visit hexagonmi.com.

Learn more about Hexagon (Nasdaq Stockholm: HEXA B) at hexagon.com and follow us [@HexagonAB](https://twitter.com/HexagonAB).