

Gageline – Dimensional metrology

Precise quality control at every stage of the production process



Precise metrology for efficient quality control

As a leading manufacturer of metrology systems, HOMMEL ETAMIC offers a broad portfolio of measurement solutions for industrial manufacturing processes. Our technologies include pneumatic measurement, tactile or optical measurement of roughness, contour, form and dimensional features, as well as optical inspection of machined surfaces.

Comprehensive services such as consulting, training, DAkkS-DKD calibration and service, including long-term maintenance contracts, round off our worldwide range

of metrology services for quality assurance in industrial manufacturing.

Our measuring systems ensure the quality of the workpiece throughout the entire production process and provide precise measurement data in the shortest possible time. Automatic measuring technologies enhance overall productivity during production through efficiently designed inspection solutions – whether inline or offline, or using spot checks through 100 % inspection of all manufactured workpieces.



Pneumatic metrology



Tactile metrology

Gageline. Dimensional metrology in every production stage

Gageline solutions are flexible and take into account any special requirements of the measurement task, required automation, part handling, and even the machine layout. We offer standard and custom designed solutions for any application, capable of providing real-time quality control data anywhere in your production process.

Gageline product range

- Manual measuring gages
- Semi-automatic measuring stations
- Fully automated measuring machines
- Tactile and pneumatic sensors
- Displays and measuring computers with evaluation software

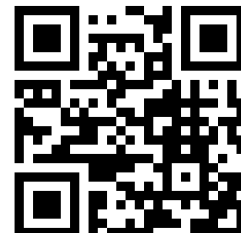
Applications

- In-line and off-line
- Pre- or post-process
- Final inspection
- Metrology lab
- Statistical process control (SPC)
- 100 percent control
- Sample measurements

Additional tasks

- Weighing
- Classification
- Signing
- Sorting
- Optical surface inspection

Please scan for detailed
Gageline information



Custom metrology solutions for any industry

Gageline provides you with solutions for high-precision dimensional measurement in almost any environment, regardless of processes, cycle times, or specific production related requirements like temperature or cleanliness. Our custom solutions offer a high level of specialization and reliability to our customers in medical, aerospace, and automotive manufacturing as well as other mobility industries.

Industries and application examples

Automotive

- Connecting rods
- Injector components
- Gear components
- E-motor components



Mechanical Engineering

- Bearings
- Pump housings
- Rotor shafts
- Sockets

Medical

- Femoral top prostheses
- Femoral pivot prostheses
- Tibial prostheses
- Glass tubes



Aerospace

- Driving shafts
- Bevel gears
- Hydraulic components
- Turbine components

Heavy Duty Trucks

- Cylinder heads
- Cylinder blocks
- Shafts
- Differential carriers



Recreational Vehicles

- Brake disks
- Pump bodies
- Gearbox housings
- Valve bodies

Heavy Equipment

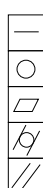
- Hydraulics
- Transmissions
- Brake cylinders
- Turbo chargers



Railroad

- Gears
- Housings
- Shafts
- Centering plates

Dimensional characteristics measured with Gageline solutions



Straightness



Roundness



Flatness



Cylindricity



Parallelism



Perpendicularity



Angularity



Coaxiality



Radial/axial run-out



Total radial/axial run-out



Diameter (inner/outer)



Conicity



Location



Length



Profile form

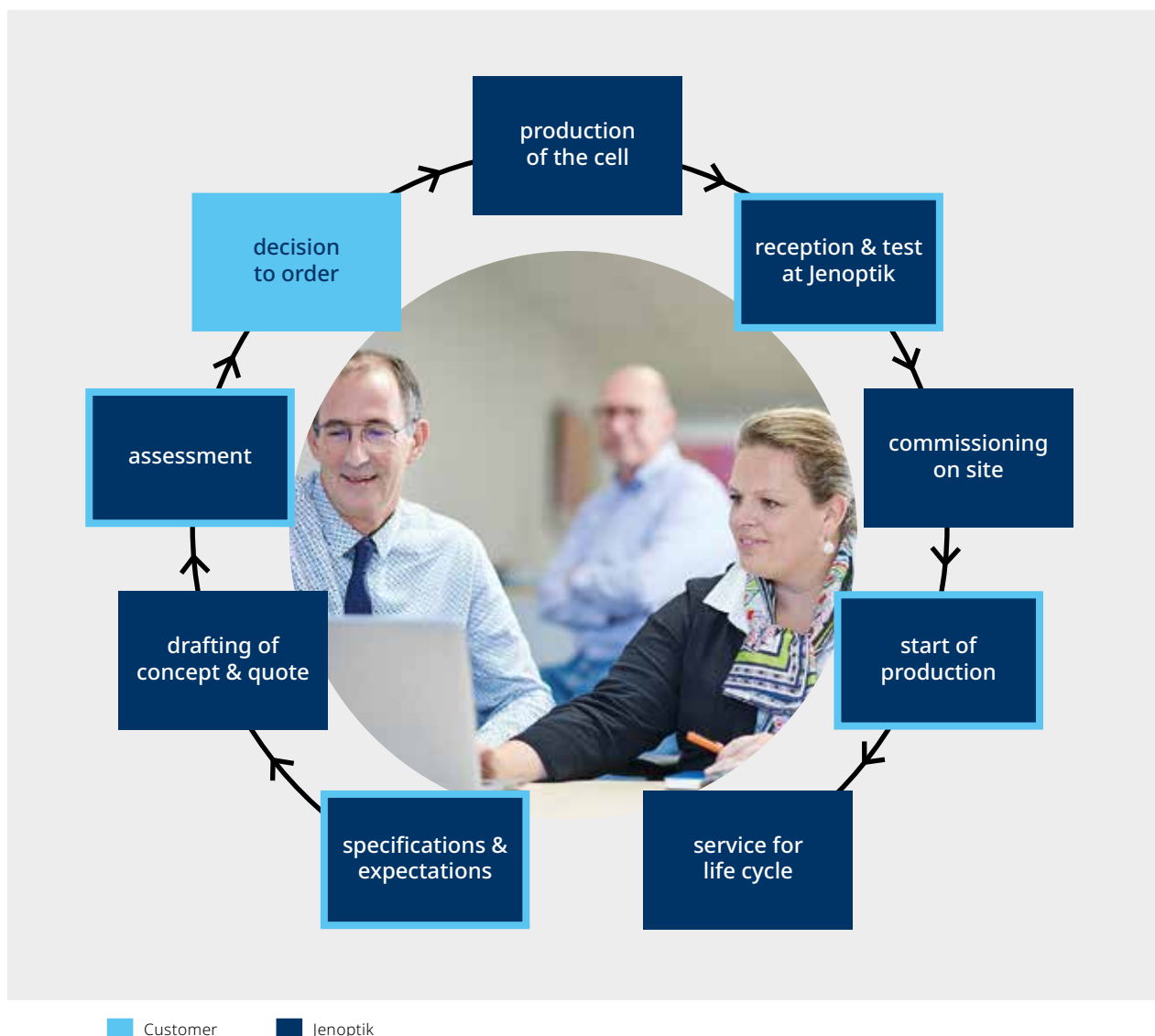
Individual solutions for applications worldwide

Benefit from our know-how in handling local and international projects:

- Expert sales, engineering and service worldwide
- Decades of experience designing, engineering and integrating custom dimensional measuring solutions
- Versatile technologies using tactile or pneumatic sensors

We are a global metrology partner with subsidiaries and distribution partners in key industrialized nations. Experience our technologies at one of our many customer centers and benefit from our extensive expertise in handling both local and international projects. Our project teams can provide solutions individually tailored to fit any manufacturing requirements.

Turnkey projects: Get all from a single source



From simple measuring stations to fully automated solutions

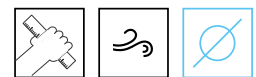
Gageline offers dimensional measuring solutions that can be integrated into your production processes. The degree of automation and the technology used depends mainly on the production requirements and the measuring task.

Gageline solutions are robust and precise thanks to "plug-and-play" technologies that can be used as stand-alone control devices, or integrated into manual, semi-automatic, or fully automated measuring solutions that deliver scalability and evolve with your processes.

Dynamic measurements as well as statistical process control (SPC) insure part quality through interlinked measuring machines that are integrated into the production line.

The following pages show examples of Gageline applications ranging from simple, manual measuring stations, to fully automated measuring machines, all capable of being seamlessly integrated into your production processes.

Simple, cost-effective measuring chain



Manual table-top gage for inner diameters

Simple manual measuring stations consist of three basic components: a measurement display, a pneumatic or tactile measuring device, and a master (standard). These gages are inexpensive, easy to use, do not require prior knowledge and deliver immediate measurement results.

Customer requirements

- Workpiece: ball joint pickle fork separator
- Measurement of two inner diameters
- Post-process, 100 percent control operation

Gageline solution with air tooling

- Mounting on table
- 2 Pneumatic digital comparators
- 1 air spindle with 2 levels for the 2 diameters and elongated jets to take into account the surface finish
- 2 standards according to DIN 2250 B (Min/Max)

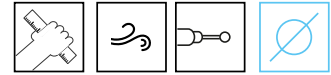
Special features

- Immediate display of measurement results
- Ease-of-use
- Portability



Air spindle with two elongated jets

Expandable bench gage measuring system



Manual bench gage for shafts

Measuring stations similar to these are normally placed close to the production line and can be used for taking sample measurements, or for final inspection. Work-piece loading/unloading, measuring and mastering are completed manually by the operator.

Customer requirements

- Workpieces: Drive shafts of a ten-speed gearbox
- 3 shaft types
- Multiple O.D. sizes ranging from 23 to 39 mm
- Tolerance range from $\pm 7 \mu\text{m}$ to $\pm 13 \mu\text{m}$

Gageline solution with air tooling and tactile sensors

- Fully adjustable table top fixture
- Multi-sensor compact bench gage
- Carbide vee for precision part positioning
- 10 interchangeable air snap measuring devices
- 1 special tactile snap measuring device for the $\pm 13 \mu\text{m}$ tolerance range
- 2 mastering standards according to DIN 2250 B (Min/Max)



Adjustable fixture using air snap gages

Special features

- Adjustable fixture for multiple part lengths
- Interchangeable/replaceable non-contact air snap gages
- Dual pneumatic and tactile technologies for management of different tolerance ranges
- Manual air saver
- Compact measuring station

Bench gage table top system



Manual measuring station for cylinder heads

Manual measuring systems range from very simple solutions, to more complex systems that integrate dozens of different measuring devices. This is the case with cylinder head inspection with hand-held air tooling for example.

Customer requirements

- Workpiece: 2 different off-road vehicle cylinder heads which are bulky, difficult to handle and have small margins of tolerance
- Ergonomic measuring station
- Reliable measuring results
- Part features:
 - I.D. of exhaust guides, intakes and bores
 - Roundness and concentricity
 - Seat angle
 - Radial run-out of the valve seats

Gageline solution with air tooling

Bench style gaging station utilizing multiple manually operated pneumatic devices that allow the operator to fully inspect a cylinder head.

- 3 pneumatic Valvescan gages mounted on balancers (2 for intake and exhaust and 1 for the exhaust)
- 3 air gages for seat angle control and seal control
- 3 air gages for valve seat control
- 2 DIN 2250 B Min/Max standards

Special features

- Dynamic measurements
- Non-contact pneumatic measurements
- Precision air to electronic converters
- Retractable overhead reels for ergonomic workstation



Valvescan air spindle for bores

Semi-automatic I.D. and O.D. solutions



Compact pneumatic measuring station Gagline SG500

SG semi-automatic solutions are capable of static and dynamic measurements for inner and outer diameters on cylindrical workpieces.

These types of systems are suitable for:

- I.D. and O.D. checks on different levels
- Dynamic measurements for I.D. or O.D. workpieces (profile evaluation)
- Scan/Match between mated workpieces
- Conicity

Customer requirements

- Workpieces: valve body and valve shaft
- Measurement of valve body I.D.
- Measurement of valve shaft O.D.
- Automated measuring sequence
- Deviation check between mated workpieces

Gagline solution with air tooling

Table top style gaging station utilizing two semi-automatic pneumatic devices that both measure and „match fit“ valve bodies and valve shafts.

- Valve body I.D. inspection on multiple levels
- Valve shaft O.D. inspection on multiple levels
- Manual load, with automatic measuring runs
- Synchronous recording of measured values and position in Z (using CANopen motion controller)
- DIN 2550 B Min/Max standards



I.D. measurement



O.D. measurement

Special features

- IP65 protection for use on the shop floor
- Easy test plan control
- Automated measurement sequences
- High linearity due to precision high pressure pneumo-electronic transducer
- Fast measurement cycles

Semi-automatic measuring stations



Semi-automatic measuring station for seat rails



Part-specific tactile measurement

Semi-automatic measuring stations are capable of managing a high number of measurements thanks to cutting edge metrology software, fully automated sequencing and extremely capable hardware. Part loading and unloading can be completed manually, or automated through conveyor, robot, or other automatic part handling technologies. Customer specifications play a large part in determining the which one is utilized.

Customer requirements

- Workpieces: seat rails
- Dimensional measurement of
 - Profiles
 - Bearing rolling zones
 - Lock interface
- Measurement conditions
 - Cycle time <1 minute
 - Manual operator load
 - Manufacturing environment
 - Check of 40 essential dimensions, more than 120 in total
 - Different rail lengths
 - Measurement of first batch parts

Gageline solution with tactile sensors

- Semi-automatic, off-line tactile measuring solution
- ZDB inductive sensors with XP206 measuring blocks
- PS100 measuring communication modules
- CANopen communication protocol
- Sirius measuring computer with evaluation software
- Part compensation management
- Mastering standards based on part design (Min/Max)

Special features

- Robust system technology
- Industry 4.0 machine communication
- Mastering standards based on series production part
- Fast measuring times with >120 measurements per minute

Fully automated turnkey solutions



Automated in-line measuring station for gears



Robot loading

Fully automated “off-line” measuring solutions utilize tactile and pneumatic technologies, in combination with automated part handling capabilities, and are typically integrated parallel to the manufacturing line. The pneumatic and/or tactile sensors are engineered to rigorous specifications and are placed according to customer part tolerance requirements. The evaluation software manages the test plans, piloting of the part and/or sensors, and if required ensures part classification and sorting.

Customer requirements

- Workpieces: Hybrid powertrain gears
- 100 percent high speed production control
- Measurement of dimensional part features of the pinion and conformity of pinion teeth
- 4 different types of fixed gears
- 6 types of mobile gears
- >50 different controls
- Sorting of defective gears
- <30 s cycle time

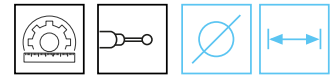
Gageline solution with tactile sensors

- 100 percent automated production control
- Optical management of gear diversity
- Dynamic measurement of center distance and roundness
- Detection of shocks on the teeth
- Sorting and storage of defective gears
- Automatic calibration of control stations
- Loading, unloading, and handling of parts by 6 axis robot
- Automatic measurement program selection
- Gear heights tolerance 100 μm , R&R <10
- Diameter tolerance <10 μm

Special features

- Fully automatic
- Detection of defective gears
- Automated part sorting and classification
- Identification and sorting of defective parts
- Integration of optical sensors

Fully automatic in-line measuring machine



Automatic bench gage for transmission shafts

Automatic measuring stations deliver user-independent, reproducible results. Robot-loading of the workpiece guarantees fast and precise positioning. Automatic measuring runs produce results within the given cycle times and allow for fast evaluation.

These stations are conceived in a project process in order to guarantee perfect implementation into the customer's production line.

Customer requirements

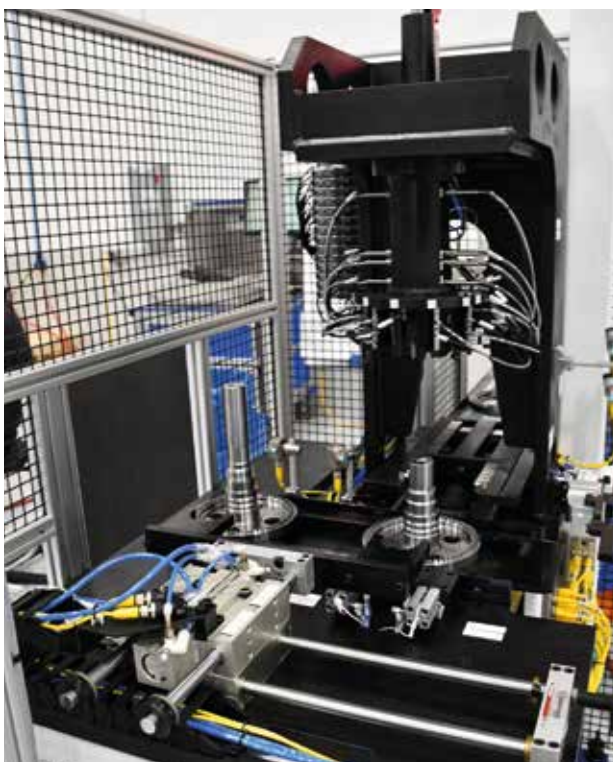
- Workpiece: output transmission shaft
- 19 dimensions to control for each part
- Automatic in-line post-process measuring gage
- 2 different shaft types (short and long)
- Cycle time: 50 s per part (part load/unload included)

Gageline solution with tactile sensors

- Fully automatic in-line inspection station with ZDB sensors
- Implementation of 2 stations: 1 for gaging and 1 for sorting
- Integrated conveyor linking the 2 stations
- Sorting station
- Measuring computer with full SPC capability and qs-STAT® certified interface
- HMI integrated into measuring computer
- Certified mean standard for short part, with adaptor for long part, and protective storage box
- Manual calibration mode
- Built-in changeover between long and short part type

Special features

- Sorting function of defect parts
- Unique measuring station managing diversity
- „Plug-and-play“ workstation



Diversity managed automatically

A wide range of components to create customized measuring solutions

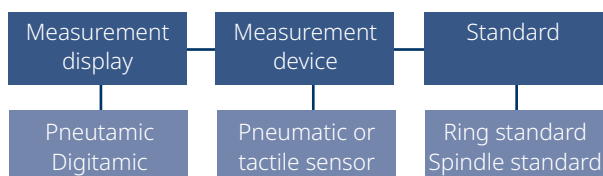
Our dimensional metrology checks diameters, lengths, distances, shape, and position of your workpieces either with tactile or pneumatic sensors depending on measuring task and process-integration. The robustness and precision of our measuring solutions are the result of the know-how we have acquired over several decades. This experience can be found in our standard modules developed in-house and which equip our customers' simplest „at-line“ manual measurement gages as well as their complex measuring machines, integrated into the most efficient production lines.

Pneumatic measurement convinces with a very high resolution. It is extremely robust and insensitive to dirt, making it perfect for use under tough manufacturing conditions. Our pneumatic process meets the high standards of DIN 2271.

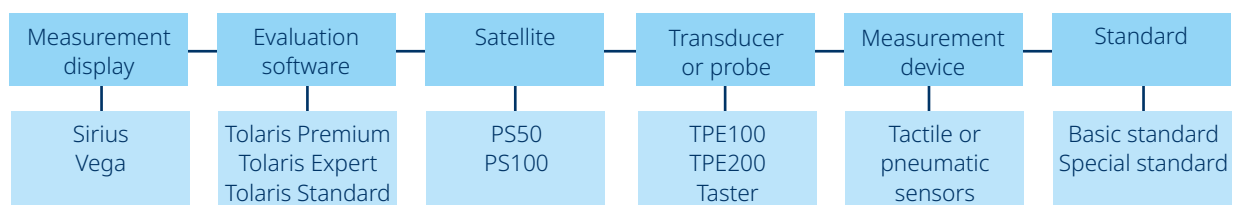
Tactile measurement uses contacting sensors that record the measured values extremely quickly. Typically, tactile sensors are used in multi-point measurement technology where the individual measured values must be recorded quickly in order to maintain a short cycle time.



Simple measuring chains for manual gages



Advanced measuring chains for more complex measuring stations and machines



The following pages provide an overview of the individual measuring components used for simple and complex measuring solutions.

Pneumatic measuring components

A pioneer in pneumatic, non-contact measurement technology, we are a world-renowned specialist with more than 70 years of experience. Pneumatic metrology uses air jets in combination with air to electronic converters to create a high pressure air circuit that allows sub-micron measurement of precision parts.

Our pneumatic technology is capable of measuring a variety of part features, including I.D., O.D., roundness, cylindricity, parallelism, conicity and even distances between axes.

Our high pressure technology delivers absolute precision even in extremely dirty manufacturing environments.

Advantages of pneumatic metrology

- Extremely high precision ($<0.1 \mu\text{m}$)
- Unparalleled repeatability ($<0.05 \mu\text{m}$)
- Robust and resistant to wear
- Non-contact
- High pressure (self-cleans parts)

Standard air tooling

Standardized air tooling uses precision pneumatic air jets for I.D. and O.D. measurements. These can be used in a variety of applications, including manual hand gages, table top bench systems, and semi-automatic off-line gages.



Air spindles AG100¹⁾

Functional diameter	$3 < \varnothing N < 150 \text{ mm}$
Measuring range	Maxi = 0.160 mm^*
Precision	$0.00025 \text{ to } 0.004^{**}$
GR&R type 2	$< 10 \%$
Capabilities (CMC)	2 to 4*



Air spindles AG200

Functional diameter	$3 < \varnothing N < 150 \text{ mm}$
Measuring range	Maxi = 0.120 mm^*
Precision	$0.00025 \text{ to } 0.002^{**}$
GR&R type 2	$< 10 \%$
Capabilities (CMC)	2 to 4*

¹⁾In special supply for air spindles, the dimensions of the parts to be measured can range from 1 mm up to 600 mm.



Air snap gages AG300

Functional diameter	$9 < \varnothing N < 105 \text{ mm}$
Measuring range	Maxi = 0.040 mm^*
Precision	$0.0005 \text{ to } 0.0015^{**}$
GR&R type 2	$< 10 \%$
Capabilities (CMC)	4



Flexible air snap gages AG380

Functional diameter	$14 < \varnothing N < 150 \text{ mm}$
Measuring range	Maxi = 0.160 mm^*
Precision	$0.00025 \text{ to } 0.002^{**}$
GR&R type 2	$< 10 \%$
Capabilities (CMC)	on demand

*Maxi = 0.060 mm at $3 < \varnothing N < 6 \text{ mm}$

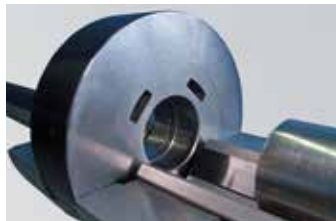
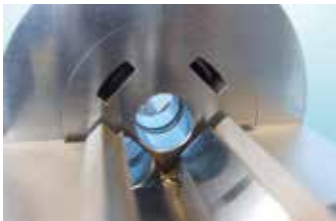
**depending on measuring range

Pneumatic measuring components

Customer engineered air tooling

Custom manufactured air tooling uses part specific engineered pneumatic circuits for inspecting a full range of dimensional and geometric part features, as well as form and positional measurements. Custom solutions can be used in a variety of applications and can utilize a variety of additional features such as part level adjusts, part vees, annular air jets, multiple measurement circuits, and much more.

AG250 air ring with annular jet



O.D. air ring with annular air jet for 360° continuous part measurement and high resolution.

AG280 air ring with standard jets for centerless grinding machines



Dynamic centerless measurements with high-speed data acquisition and high sampling frequency. Optional configurations include multi-jet air circuits, annular air circuits, and fully adjustable tooling for measuring different part sizes.

Air snap gage with three measuring planes



Snap gages can be designed with multiple air jets. In this example, 6 air jets form 3 individual diameter measurement circuits used to calculate a variety of part features like diameter, taper, etc.

Multi-jet air spindles



Small and large diameter multi-jet air spindles used for measuring a variety of applications. Left is a large diameter air spindle for crankshaft bearings, as-well-as the world's smallest air spindle (1 mm) for measuring small injector bore components.

Pneumatic measuring components

Pneumo-electronic transducers

Pneumo-electronic transducers convert air pressure from the pneumatic measurement circuit into an analog or digital CANopen signal. This signal is then processed by our metrology software for data acquisition, visual display and even machine compensation.



TPE200



TPE100



TPE99

Conversion	pneumatic-digital	pneumatic-digital or analog	pneumatic-analog
Operating temperature	0 °C to +60 °C	0 °C to +60 °C	+5 °C to 50 °C
Power supply	12–24 VDC	12–24 VDC	15–24 VAC
Pressure of air supply	3 ±0.5 bar	3 ±0.5 bar	3 ±0.5 bar
Pressure in front of air gage	1.5 to 2.3 bar	1.5 to 2.3 bar	1.5 to 2.3 bar
Protection grade	IP67	IP67	IP65
Connector	CAN bus M8 (4 pins)	M12 CANopen or 4–20 mA (8 pins)	4–20 mA
Measuring noise*	≤0.1 µm	≤0.1 µm	≤0.1 µm
Response time*	15 ms	NA	50 ms
Linearity*	0.4 % full scale	up to 0.4 % full scale	0.5 % full scale

*Characteristics determined according to standard DIN 2271

Large choice of standards



Pneumatic measurement operates off a comparison based concept. The system is engineered to measure a specific range, part sized standards are used to calibrate the system and then actual parts are measured and “compared” to the calibrated standard.

We maintain a large range of standards in stock, which allows us to conceptualize, engineer, build and test pneumatic systems quickly and efficiently.

Standards for air tooling

Tactile measuring components

Tactile measurement technologies offer excellent quality, reliability, and robustness. Tactile sensors are particularly suited for large tolerance ranges of >120 µm and for workpieces with distinctive roughness characteristics.

Inductive sensors ZDB (LVDT*)

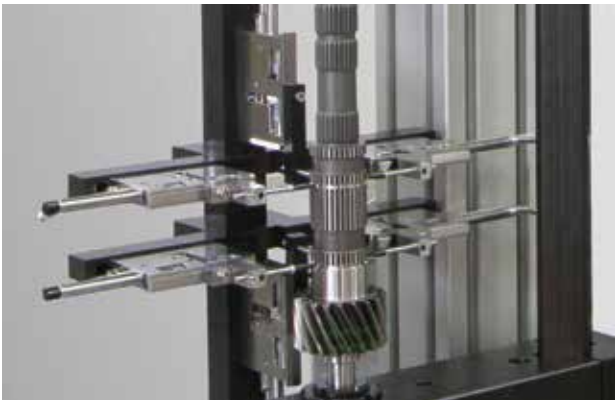


	Straight LVDT sensor	Straight LVDT sensor with pneumatic lifting	Straight LVDT sensor with pneumatic push
Measuring range	±0.3 mm to ±10 mm	±1 mm to ±5 mm	±1 mm to ±5 mm
Measuring force	0.7 N	0.6 N	0.35–0.85 N at 0.4 bar 1.9–2.5 N at 1 bar
Non-repeatability (precision)	<15 or <30 µm (depending on type)	<15 µm	<15 µm
Operating temperature	-10 °C to +80 °C	+5 °C to +80 °C	+5 °C to +80 °C
Protection grade	IP65	IP65	IP65

	Mini LVDT sensor	Straight LVDT sensor with floating core	
Measuring range	±0.25 mm to ±1 mm	±1 mm to ±2.5 mm	
Measuring force	0.7 N	NA	
Non-repeatability (precision)	<15 µm	<15 µm	
Operating temperature	+5 °C to +80 °C	-10 °C to +80 °C	
Protection grade	IP65	IP65	

* LVDT = Linear Variable Differential Transformer; inductive sensors with electrical transducer for measuring linear positions

Measuring blocks



Measuring system with several measuring blocks

XP style measuring blocks enable precise sensor positioning and allow for an extended stroke range.



- Fully stainless steel and Viton valve
- Stroke from 1 to 11 mm depending on type
- Clamping for all types of sensors
- Interchangeable thrust spring and low measuring force
- Lifetime up to 20 million cycles
- Constant measuring pressure
- Mechanical protection of the sensor

Data processing of dimensional measurements

Digital comparators

The Pneutamic and Digitamic are electronic comparators used to visually display information from a pneumatic or tactile measurement circuit. Easy to use, they do not require any adjustment and can be used by operators without any particular expertise in metrology.

- Up to 5 measurement programs
- Wide range of available sensors
- Reliable and durable
- Shop floor hardened
- Static or dynamic measurements available
- Easy to install/use
- Up to 8 linkable in a series



Pneutamic



Digitamic

Probe satellites

Probe satellites function as a receiver for pneumo-electronic transducers, or LVDT tactile sensors. Each measurement circuit is attached to one channel on the probe satellite, which corresponds to an assigned I.D. in the evaluation software.

The PS50/100 probe satellites can perform dynamic or static dimensional measurements, with the option of connecting to a large variety of either Jenoptik, or other commercially available sensors.



PS100



PS50

Ethernet	Switch 100 Mbps	Switch 100 Mbps
Power supply	24 VDC $\pm 20\%$	24 VDC $\pm 20\%$
Protection grade	IP54	IP54
Operating temperature	0 °C to +45 °C, relative humidity max. 80 %	0 °C to +45 °C, relative humidity max. 80 %
Dimensions	295 x 150 x 65 mm [W x D x H]	195 x 150 x 65 mm [W x D x H]
Weight	2.2 to 2.7 kg (depending on type)	0.8 to 1.0 kg (depending on type)
Number of types	10	8
Number of entries	16	4
Types of entries	LVDT, HBT, 4–20 mA, ± 10 V, opto, incremental, relay	LVDT, HBT, 4–20 mA, ± 10 V, opto, incremental, relay

Measuring computers for control and evaluation of dimensional measurements

Sirius and Vega industrial computers can be combined with Tolaris Premium and Tolaris Expert evaluation software, to offer flexible solutions that help control your production processes.

They are designed for dimensional measurement analysis, as well as for encoder and joystick control.

Advantages

- Suitable for harsh production environments
- Ultra-simple user interface with touchscreen
- Flexible USB and Ethernet interfaces
- Profibus, Profinet or CANbus/CANopen
- Compatible with both Jenoptik and other commercially available probe satellites



Sirius

Touchscreen	18.5" TFT LCD, 1920x1080 pixel, Full HD touch
Processor	Intel Atom QuadCore E3845 1.9 GHz
DRAM	8 GB DDR3
Memory	128 GB SSD SATA
Operating system	Windows 10 IoT
Interfaces	2 x COM (RS232), 2 USB 2.0, 1 USB 3.0, 1 DP
Power supply	115/230 VAC
Options	Profibus, Profinet, CAN bus/CANopen, Ethernet
Dimensions	533.5 x 354.5 x 81.55 mm [L x H x D]
Protection grade	IP69 on the front panel, IP66 on other faces
Weight	15 kg
Certifications	CE, CCC compatible

Sirius shown with Tolaris Premium main screen



Vega

Touchscreen	10.4" TFT, GA 1024x768 pixel, resistive touch
Processor	Intel Atom x7-E3950 Quad Core 2.0 GHz
DRAM	8 GB DDR3
Memory	120 GB SSD
Operating system	Windows 10 IoT
Interfaces	1x COM 1 (RS232), 4x USB
Power supply	12–24 VDC
Options	Profibus, Profinet, CAN bus/CANopen
Dimensions	270 x 217 x 64 mm [L x H x D]
Protection grade	IP65 on the front panel
Weight	2 kg
Certifications	CE

Vega shown with Tolaris Expert main screen

Tolaris Premium & Tolaris Expert.

Performant operating and evaluation software

Our flexible evaluation software offers solutions for all dimensional, geometric, form and positional measurements, for off-line, in-line, SPC, pre and post-process production applications. Both software packages offer full function, graphical user interfaces that are easy to use even for demanding measuring programs.

Interfaces & data export

- qs-STAT® (Q-DAS) statistics export interface
- Customizable ASCII csv export
- Profibus, Profinet, CAN bus/CANopen, Ethernet/IP (Premium only), RS232 (Expert only)
- Probe satellites PS50 or PS100
- MS10 data capture modules

Tolaris Expert



Tolaris Expert: Test plan creation with characteristics

Specific features Tolaris Expert

- Use with Vega industrial computer
- Up to 32 probes
- Multiple help tools for test plan creation and operation
- Test plan selection via PLC input, sensor values or manual
- Use of test plan templates for different projects
- Up to 100 test plans for measurement and calibration
- Up to 64 measurements per test plan
- Ranking
- Printable measurement report or PDF format
- Display of up to 16 measurements simultaneously
- Display of statistics for statistical process control (SPC)

Worldwide availability

Our expert teams are available to assist you wherever you are located. We have subsidiaries and distribution partners in key national nations, in order to assist our customers as a reliable production partner.

