



KLINGELNBERG

DONE IN ONE

Measurement Solutions for Roller Bearings (G series)



KLINGELNBERG Group: **Tradition, Expertise and Passion**

The **KLINGELNBERG Group** is a world leader in developing and manufacturing machines for bevel gear and cylindrical gear machining and precision measuring centers for axially symmetrical components and gears. The Group also manufactures spiral-cut bevel gears to customer specifications – with ultimate precision using in-house technology.

The machine and software concept of the **KLINGELNBERG Precision Measuring Centers business division** is optimized for measuring complex components. The technology replaces up to six conventional measuring machines: gear measurement, general coordinate measurement, optical measurement, form and position measurement, roughness measurement and contour measurement. These measurement tasks can be fully automated in a single clamping. KLINGELNBERG Precision Measuring Centers ensure that reliable measuring results are obtained not just in measurement rooms and geometry laboratories, but also in the shop-floor environment. It is not without reason that the KLINGELNBERG Precision Measuring Centers represent a widely used standard in the industry and serve as a reference for metrology institutes.

The origins of this machine manufacturer date back to 1863. Still today, the Klingelberg family remains invested in the company as an anchor shareholder. With numerous R&D engineers worldwide and more than 200 registered patents, the company demonstrates its capacity for innovation each and every day. Klingelberg operates engineering and manufacturing facilities in Switzerland, Germany, and Hungary. The company ensures a global presence with regional sales and service offices.



Hückeswagen, Germany



Zürich, Switzerland

Precision Measuring Centers in Sync

- Modern, rail-guided, flow production assembly line with ten workstations in final assembly
- Clear definition of worksteps
- Reduction of unproductive extra work
- Timely deliveries via a reliable timetable
- Visualization of the project status and the required material for each station on centrally installed monitors
- Transparency with other areas of the company, e.g. sales and warehousing



Flow production, Hückeswagen

DONE IN ONE MEASUREMENT SOLUTIONS

Roller Bearings: KLINGELNBERG Solutions for Complete Measurements

Roller bearings have to perform several different tasks at once: they have to ensure high stability for shafts while providing low power losses and high durability. The resulting requirements concerning material, geometry, form accuracy and surface roughness represent a particular challenge for manufacturing. In light of high precision requirements, quality can be ensured in the classic sense only by using different measurement equipment. Dimensions are thereby measured on a coordinate measuring machine, form and noise emission on a form tester, surface roughness on a surface tester and contours (e.g. edge radius) on a contour measuring station. This results in high investment and operating costs. Finally, the operator has to setup the workpiece on all different stations, which makes the measuring process quite long and produces an enormous amount of work for the operator.

KlingelInberg follows the approach of executing these processes in one stage as a complete measurement (Done in one). A KLINGELNBERG Precision Measuring Center is capable of fast measurement of dimensions, form, contour and surface roughness in one automated cycle. This reduces the investment costs and helps to **reduce the process costs by an average of 46% compared to current practices in the industry**. Furthermore, the precision measuring centers also ensure the required measuring accuracy if they are used directly in production. As a result, not only does this save on air-conditioning costs, but the measuring center can also be directly integrated into the production process.

Conclusion:

KlingelInberg combines its knowledge from precision metrology and machine tools to ensure its unique combination of precision and robustness.



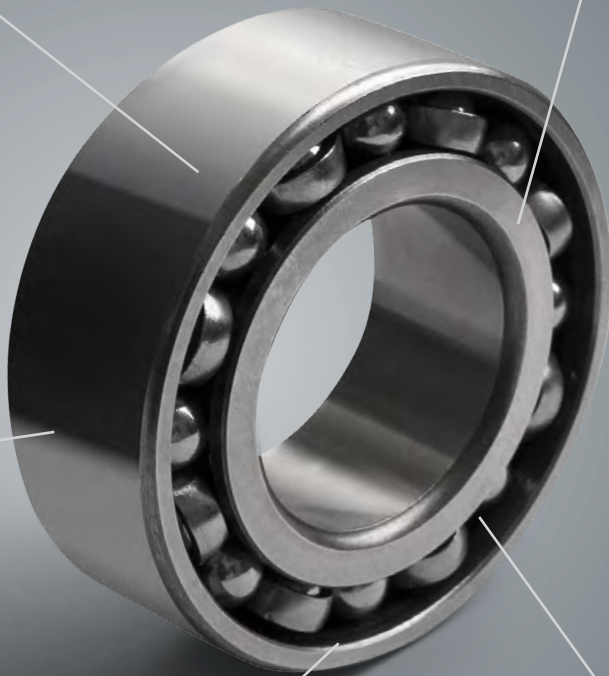
Roughness measurements outside

**UP TO 46% SAVINGS
IN PROCESS COSTS**

GD&T dimensional measurements



GD&T form and position measurements



Roughness measurements inside



Contour measurements

HIGHLIGHTS

Precise and Efficient from the Ground Up



P 16 G precision measuring center

The measuring technology and machine design are the same for the G-series of the precision measuring centers. All machine models can be enhanced with individual options.

- Optimally harmonized model series for all typical industrial applications
- Cost reduction due to minimum space requirements and a particularly low-maintenance technology
- Suitable for use in production thanks to temperature compensation – reliable results, even in the +15°C to +35°C range
- Protected guides, drives and measurement systems at the axes allow for seamless use
- Great savings in energy costs due to extremely low power and air consumption (1l/ min)



Measurement on the Shop Floor

- The highest specifications in the production environment (from +15 to +35°C) with great temperature gradients for time and space
- Reliable and proven machine and workpiece temperature compensations
- Resists external environmental influences and vibrations thanks to active vibration damping (optional)
- Environmentally resistant components for safe use in production



Magnetic, Electromechanical Clamping System

- Automatic centering of the bearing rings
- Bearing rings do not deform thanks to the magnetic clamping system
- Workpiece clamping does not affect measuring results
- Collision and dimensions are automatically included in measurement planning thanks to software-based wizard technology



High-precision Workpiece Rotary Table for GD&T, Form and Contour Measurements

- Ideal for form measurements with $< 2 \mu\text{m}$ roundness tolerances
- Suitable for position-tolerated characteristics, such as coaxialities, axial runouts and total concentricities for the greatest measuring accuracy
- Intricate, low-tolerance contour measurement
- An intelligent machine design allows for comprehensive waviness analyses



Easily Scan Contours on Roller Bearing Running Surfaces

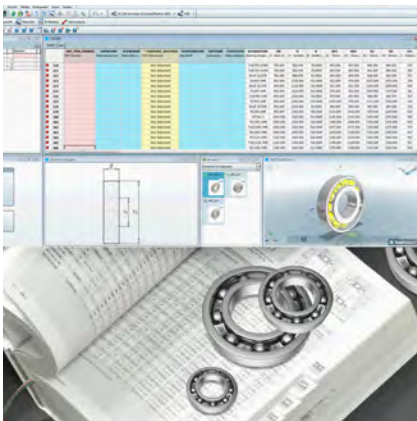
- The smallest sections and contours on running and support surfaces are measured
- Premium quality thanks to high point density
- High-resolution scanning 3D tracer head with digital measurement acquisition in all coordinate directions
- Probe diameter available in 0.1 mm and greater as standard

HIGHLIGHTS



Fully Automatic Roughness Measurement Inside and Out

- Output values according to DIN EN ISO 4287 (DIN 4762) and DIN EN ISO 13565-2
- Filtering according to DIN EN ISO 16610, DIN EN ISO 113565 and limit wave length λ_C and micro roughness filter λ_S
- Roughness measurement can even be performed on the smallest contours
- Fast Fourier transformation (FFT) analysis to determine roundness errors and undesired noise emission



Automatic Program Generation of Measuring Runs of Various Types and Dimensions

- Only one program needed for all the dimensions of a bearing type
- Customized and automatic selection of characteristics based on requirements and needs
- All interfering edges are included in the measuring run
- Plausibility checks for probes and characteristics as early as during the setup process
- Automatic classification into precision classes according to measuring results



Incredibly Easy Operation with the Intuitive EasyStart Graphical User Interface

- Intuitive graphical user interface in Microsoft® Windows® provides easy and secure operation with minimal training
- Simple input and information via windows, tile appearance, code information (e.g. data matrix code, barcode)
- Automatic recording, saving and processing of data results with high data security and minimization of operating errors



Maximum Safety with Collision Protection

- Software operator guidance with plausibility check of program data
- 3D tracer head with deflection motion monitoring via sensors and a mechanical protective device
- Probe change rack with bistable magnet holding system for easy handling and reliable collision protection
- Monitored measuring axis drives with overload protection function



Quick Availability of Measuring Results Enables Huge Time Savings

- Correction of measuring results for workpiece temperatures deviating from the reference temperature in the +15 to +35 °C range
- Measurement of the current workpiece temperature via a fast thermo-element
- Algorithm can be used for all metallic/axially symmetrical workpieces



Done in one – the Complete Solution for Bearing Measurements

Complete measurement in one clamping, one piece of software and in one cycle:

- Geometrical dimension and tolerancing (GD&T) measurements
- Form and position measurements
- Roughness measurement on running surfaces and contours
- Contour measurement
- Fast Fourier transformation (FFT) analyses



Incredibly Easy Operation for Complete Measurement of Complex Components

Software is a key factor in measuring device performance. It also provides simple and intuitive operation in the G-variant: either the workpiece ID number is selected or a barcode/QR code scanner is used in the EasyStart screen to start the measuring run automatically. All mandatory evaluation parameters for components according to national and international standards can be tested, as well as specific requirements.

The CNC control transmits the measured values online to the evaluation software, where the results are evaluated and logged. During the measurement itself, the program displays results on the screen and then prints all the relevant information on easy-to-read measuring sheets. The measuring results can also be saved locally or via a network, and also transmitted to a statistics program (qs-STAT).

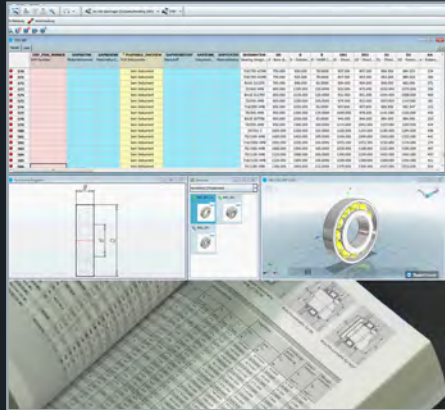
Since the G-variant is equipped with O-QIS software, the quality control map can be evaluated. In this case, the measuring run also begins automatically as soon as the workpiece ID number is selected.

- EasyStart program for selecting different software modules
- Fast measurement program creation via buttons
- Catalog of stored measurement programs with search functions
- Custom language selection in the operator guide/documentation
- qs-STAT interface and connection to a quality control map
- Fully automatic measuring run with all parameters of the GD&T form, position, contour and roughness measurement



Done in one – the Complete Solution for Roller Bearing Measurements

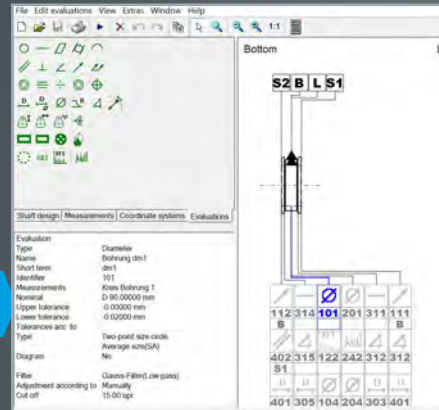
Roller bearing information



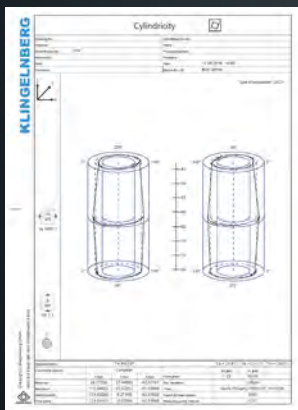
Generator

**AUTOMATIC
MEASUREMENT
PROGRAM
GENERATION**

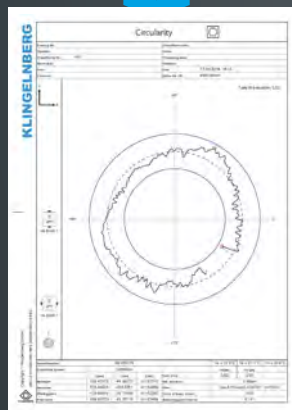
Software graphical user interface



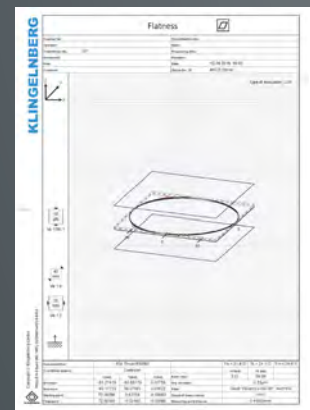
DETAILED ROLLER BEARING MEASUREMENT ANALYSES AND EVALUATIONS



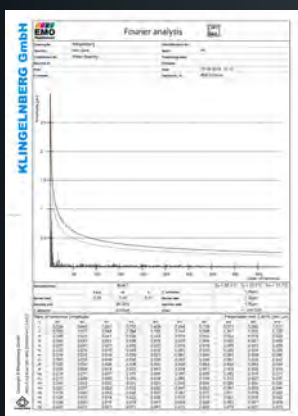
GD&T evaluations



Form and position evaluations



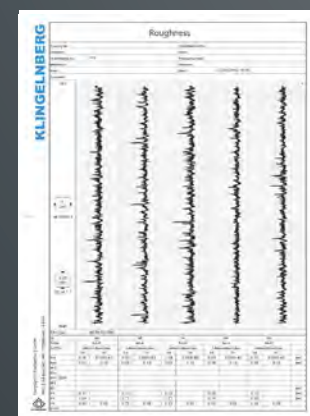
Geometric evaluations



Fast Fourier transformation
analysis






GD&T protocols



Roughness evaluations

PRODUCT PORTFOLIO

	P 16 G	P 26 G
Outer clamping diameter (min. – max.)	Ø 0 mm – 160 mm	Ø 0 – 260 mm
Horizontal measuring range (X axis)	+/- 50 mm	±75 mm
Vertical measuring range (Z axis)	250 mm	400 (550)* mm
Permissible moment of inertia (max.)	0.1 kgm²	1 kgm²
Permissible test gear weight (max.)	20 kg	80 kg
Measuring accuracy while maintaining the reference temperature in the measurement room / production environment 18-22°C (0.5 K/h; 2 K/d; 2 K/m) / 15-35°C (2 K/h; 12 K/d; 2 K/m)		
MPEE0 ISO 10360-2	1.8 µm + L/450 mm*** / 1.8 µm + L/250 mm***	
Concentricity and axial runout in accordance with DIN EN ISO 1101	0.3 µm / 0.5 µm	
Straightness according to DIN EN ISO 1101	0.4 µm / 0.6 µm	
Coaxiality according to DIN EN ISO 1101	1.2 µm / 1.4 µm	
VDI/VDE 2631 swivel guide deviation	0.2 µm (0.1 µm)* / 0.4 µm (0.3 µm)*	
Gear measurement according to VDI/VDE 2612 sheet 1 and 2, and 2613	Group I	
Roughnesses		
Range of application	0.05 µm to 10 µm (Ra)**	
Measurement uncertainty (Ra)	±(3% + 20 nm) **	
Filtering	ISO 16610 / ISO 13565	
Limit wavelength λc	0.08 / 0.5 / 0.8 / 2.5 mm	
Micro roughness filter λs	0 / 2.5 / 5 / 10 µm	
Parameters	ISO 4287	
Machine service readiness	+10 – +50°C	
Nominal power of the machine incl. printer approx.	0.7 kVA	0.9 kVA
Compressed air connection	-	6 bar / 60 l/h
Net weight, incl. standard equipment approx.	990 kg	1,600 kg
Machine dimensions (L x W x H) approx.	1,305 x 840 x 1,620 mm	1,465 x 1,355 x 1,680**** mm
<div><div><p>* Optional on request</p><p>** Accuracy values according to the processes and configurations described by Klingelnberg</p><p>*** Reduced shape in axis-parallel direction</p><p>**** Dimensions for machine type without vibration isolation</p></div><div></div><div></div></div>		

P 40 G	P 65 G
Ø 0 – 400 mm	Ø 0 – 650 mm
±115 mm	±200 mm
550 (700)* mm	800 mm (1,200 mm)*
5 kgm ²	30 kgm ²
300 kg	500 kg
1.8 µm + L/450 mm*** / 1.8 µm + L/250 mm***	
0.3 µm / 0.5 µm	
0.4 µm / 0.6 µm	
1.2 µm / 1.4 µm	
0.2 µm (0.1 µm)* / 0.4 µm (0.3 µm)*	
Group I	
0.05 µm to 10 µm (Ra)**	
±(3% + 20 nm) **	
ISO 16610 / ISO 13565	
0.08 / 0.5 / 0.8 / 2.5 mm	
0 / 2.5 / 5 / 10 µm	
ISO 4287	
+10 – +50°C	
1.5 kVA	2.2 kVA
6 bar / 60 l/h	
2,300 kg	3,600 kg
1,535 x 1,630 x 1,960**** mm	1,770 x 2,125 x 2,430**** mm
	

Additional sizes on request

Talk to us if you have special requirements for part size, measurement tasks and evaluation.

Contact:

gearmeasuring@klingelnberg.com

Video on roller bearing measurement

The Klingelnberg Done in one comprehensive solution for bearing measurements. You can find our video at the following link (QR code):



Large Roller Bearings on Wind Turbines

Wind turbines require continuously rotating roller bearings. They ensure that the rotor and its blades consistently rotate axially on its own axis. These high and permanent rotations require the utmost precision and accuracy, which mainly pertains to the tolerance for the form and position of the individual roller bearings and their elements. Lubrication generally takes place via an oil or grease guide. It requires that the tracks and contours have the corresponding roughness tolerances. Among other things, triple-row roller bearings or dual-row tapered roller bearings are used in wind turbines. The goal of using them is to give the roller elements optimum roller behavior. It places high accuracy demands on the shape of the running surfaces.



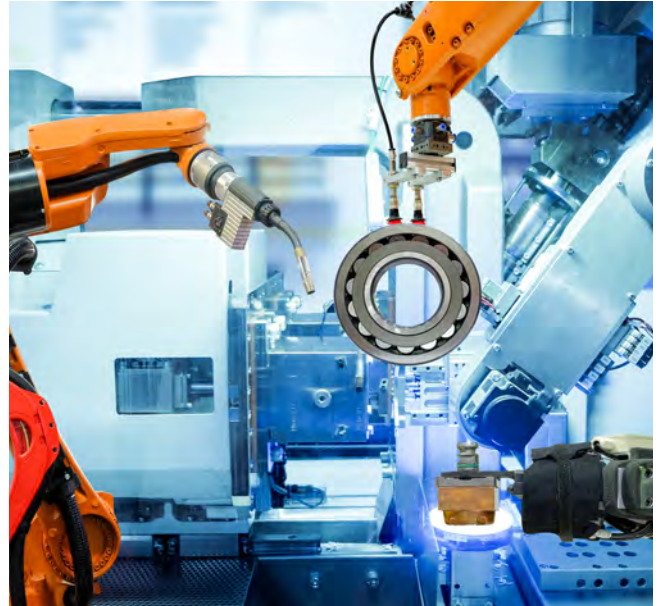
Large Roller Bearings in Mining, Construction Machines and in Shipbuilding

Large bearings up to six meters in diameter are put under realistic loads for ship engines, mining, the cement and steel industry, etc. This calls for high quality standards for the individual components and assemblies to ensure the long service life that is required of these large systems. Due to the sizes, the requirements in this case must be measured with high quality and suitable for production. Furthermore, these measurements should be performed at different temperature drifts, if necessary. For good measure, large roller bearings with unusually high loads are installed with more material than calculated. Reliable and traceable results can be used to optimally calculate the materials. In addition, the durability and operational reliability of large roller bearings can be increased based on the measuring results.



Roller Bearings in Robot Joints

Roller bearings give robots mobility, with the important aspects being resilience, dynamics and precision. Due to the high and consistent loads along with the desired maximum availability level, the utilized roller bearings of high precision classes also need to be measured with high precision and in a comprehensive manner. The G-variants of the KLINGELNBERG Precision Measuring Centers offer comprehensive roller bearing measurement in one clamping, one alignment and in one cycle. This ensures that the necessary precision can demonstrably be used at the highly stressed position with the expected duration in the particular production environment.



Roller Bearings in the Automotive Industry

The main design of the typical roller bearing for the automotive industry is for the inner ring and outer ring to be separated by roller bodies. They act as a fixed or floating bearing for attaching axes and shafts; they absorb the radial and axial forces and simultaneously enable the rotation of the shaft or the components (e.g. a gear) that are rotatably mounted on an axis. At the same time, the friction and thus the power loss and wear should be kept as low as possible. Therefore, detailed tests related to dimensional, form, position and roughness measurement must be performed for each component with high quality and with the utmost precision. Reliable and traceable results can also allow for each part to be ideally paired. This results in the highest quality, high wear resistance and absolute safety.



KLINGELNBERG Service

The Klingelberg Group is a world leader in the development and manufacture of machines for bevel gear and cylindrical gear production, precision measuring centers for gearing and axially symmetrical components, and the production of customized high-precision drive components. In addition to the headquarters in Zurich, Switzerland, further development and production facilities are located in Hückeswagen and Ettlingen, Germany, and in Győr, Hungary.

The company also has sales offices and service centers and numerous trade representatives worldwide. On this basis, Klingelberg offers users a comprehensive range of services for all aspects of toothed gear design, manufacturing, and quality inspection. The spectrum includes technical consulting, on-site machine acceptance, operator and software training as well as maintenance contracts.

KLINGELNBERG Solutions

Klingelberg solutions are used in the automotive, commercial vehicle, and aviation industries, as well as in shipbuilding, the wind power industry, and the general transmission manufacturing industry. With numerous R&D engineers around the globe and over 200 registered patents, the company consistently demonstrates its capacity for innovation.

KLINGELNBERG AG

Binzmühlestrasse 171
8050 Zürich, Switzerland
Fon: +41 44 278 7979
Fax: +41 44 273 1594

KLINGELNBERG GmbH

Peterstraße 45
42499 Hückeswagen, Germany
Fon: +49 2192 81-0
Fax: +49 2192 81-200

KLINGELNBERG GmbH

Industriestraße 19
76275 Ettlingen, Germany
Fon: +49 7243 599-0
Fax: +49 7243 599-165

You can also find your local contact for sales advice at www.klingelberg.com/contact.