

KLINGELNBERG

P 200 | P 300 | P 400

PRECISION MEASURING CENTERS



KLINGELNBERG

Sustainable Quality Management of Drive Elements

Stringent precision requirements for gear tooth measurements and increasingly complex drive components demand the best measuring technology available and a machine and software concept optimized for these applications. That's why leading manufacturers put their trust in Klingelberg precision measuring centers, which represent the most widely used standard in the industry, while also serving as the reference for metrology institutes.

Klingelberg measuring centers (P series) today are ideally suited to handle most measurement tasks in a wide range of sectors: Users in the automotive and commercial vehicle industries, the aerospace and aeronautical engineering industries as well as the wind power industry rely on this technology, **which replaces up to four conventional measuring devices**. This allows the following measurement tasks **to be fully automated in a single setting, even right along the production line**:

- Gear measurement
- Dimension, form and position measurement
- Roughness measurement
- Measured value analysis

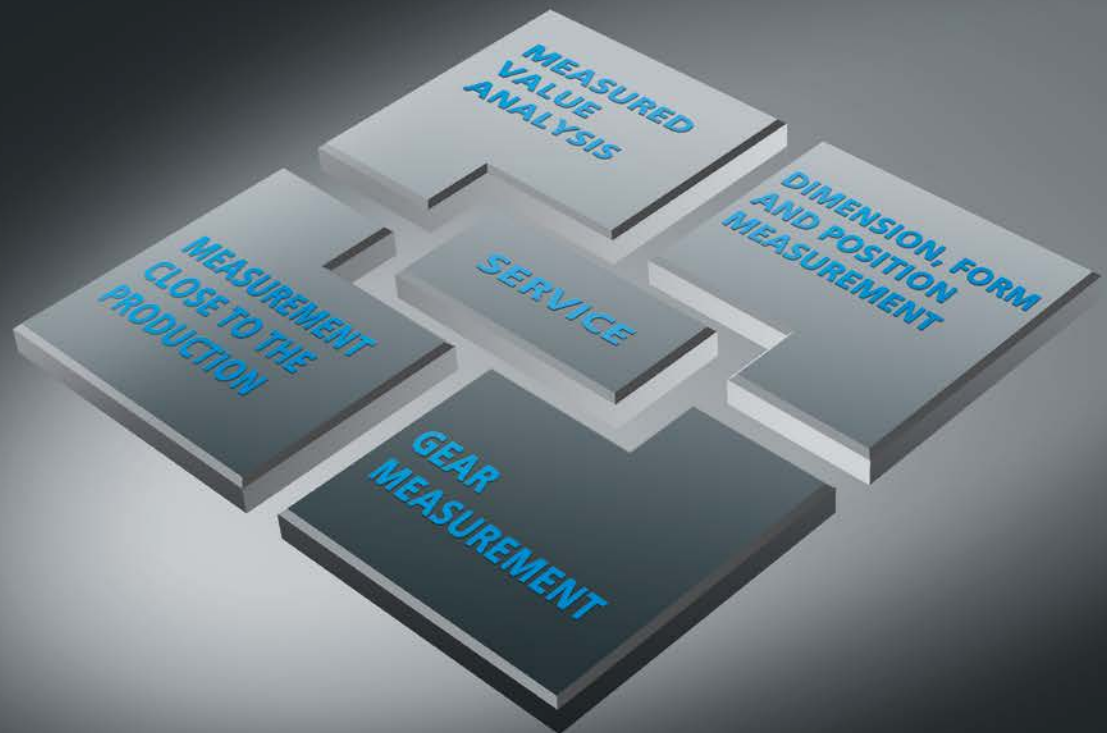
The modular concept used in the P series offers measuring devices in just the right size and a broad range of applications, providing the utmost accuracy:

- Measuring centers for workpieces up to 4,000 mm in diameter and weighing up to 20,000 kg
- Gear measurements starting from a module of 0.2 mm



P 350 – workpiece diameter range up to 3,800 mm

Five Areas of Expertise. Unique Solutions. Multiple Benefits.



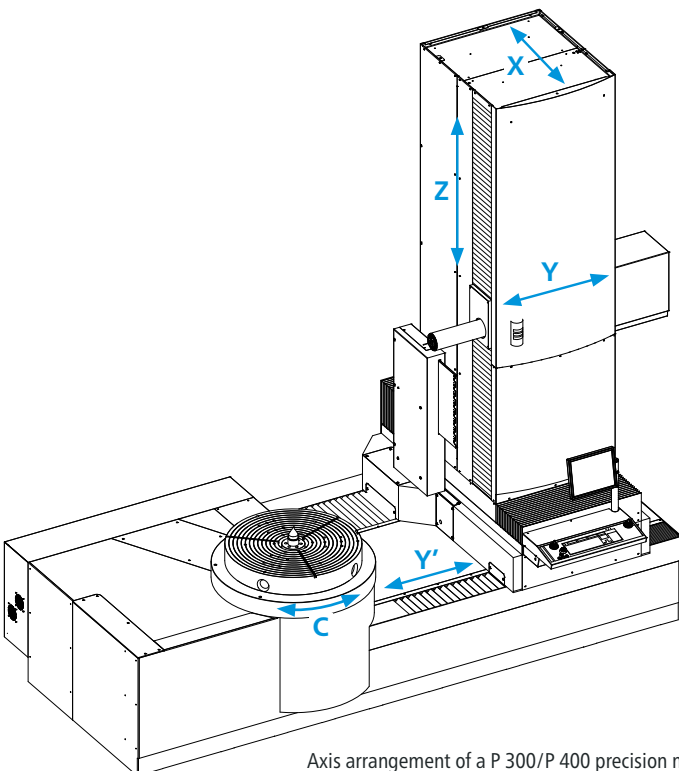
- First-class product quality ensures reliable quality assurance over the long term
- Robust measuring machine technology with minimal maintenance and calibration effort
- Excellent measuring accuracy as a basis for testing drive components of the highest quality
- Machine design suitable for use on the production floor
- Easy and safe operation of the measuring centers for all applications
- Continuous development of evaluation standards according to the industry specifications of industry and standards associations
- Comprehensive service offering: fast, competent, worldwide

Leading Technology for Maximum Safety and Precision

At the heart of a precision measuring center is an accurate, durable rotary table. Configured as a measuring axis (**C axis**), it provides concentric seating of the workpieces to be tested. In combination with the three linear measuring axes, tangential (**X axis**), radial (**Y axis**) and vertical (**Z axis**), the measuring centers trace and inspect the functional surfaces of gears and general drive components in generator mode. This guarantees maximum measuring accuracy and reproducibility. On P 300/P 400 measuring centers, the measuring axes (**X,Y, Z axis**) can also be positioned in relation to the size of the workpiece via the **positioning axis Y'**.

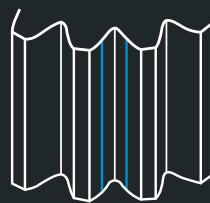
All Klingelnberg precision measuring centers are equipped with heavy-duty, stable beds and guide bodies made of cast iron. At the same time, all bearings and guides are backlash-free at the measuring axes. These form the basis for the high basic mechanical accuracy of these measuring centers. The integrated 3D tracer head enables both discrete-point probing and scanning, continuous measured value logging. The powerful software makes it possible to evaluate the results quickly and easily (see page 10 for more on the software).

- Machine design with optimal axis arrangement
- High geometrical long-term stability thanks to large components for substructure and guide bodies
- Smooth, maintenance-free AC direct drives in all measuring axes
- Powerful, intuitive software
- Efficient data management through output of measuring results via a data network connection or printout

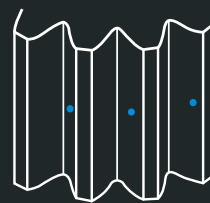


Axis arrangement of a P 300/P 400 precision measuring center

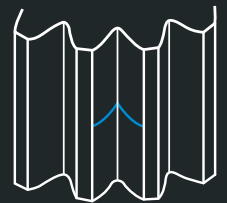
Cylindrical Gear



Tooth trace



Pitch, concentricity



Profile

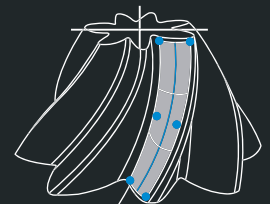
Bevel Gear



Tooth thickness



Pitch, concentricity



Topography

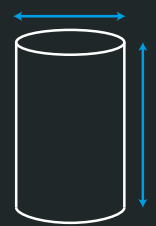
Shaft



Circularity



Straightness



Diameter, length

HIGHLIGHTS

Fully Automated Measuring Run in 19 Minutes!

A bevel gear pinion shaft is used as an example to showcase the fully automated measuring run.

- Gearing: Pinion shaft tip diameter 300 mm, overall length 1,600 mm
- Module 14, number of teeth 14, tooth width 260 mm, tooth pitch and radial run-out, topography for 3 teeth for measuring grid of 15x15 measuring points
- Radial runout and diameter at the shaft at two bearing points with evaluation in accordance with DIN EN ISO 1101
- Measurement and compensation of workpiece temperature
- Determining the workpiece axis using radial and axial runout measurement
- Fully automated measuring run

Total measurement time: 19 minutes!



Illustration example P 200 – workpiece diameter range up to 2,000 mm

Precise, from the Ground Up

The measuring technology and machine design are the same for the entire P series line. All machine models can be enhanced with individual options.

- Optimally harmonized model series for all typical industrial applications
- Minimal space requirement and particularly low-maintenance technology minimize running costs
- Suitable for use on the production floor thanks to temperature monitoring – reliable results even in the +15 °C to +35 °C range
- Protected guides, drives and measuring systems at the axes allow for seamless use



Fast and Accurate Measured Value Logging in Connection with a High-Precision Workpiece Rotary Table

- Extremely smooth-running rotary table axis in form-measurement quality
- Rotary table load up to 20,000 kg with high load reserves for impacts during workpiece loading
- Rotary table drive via AC torque motor (direct drive)
- Table plate (1,000 mm diameter) with switchable air bearing for pre-alignment of heavy workpieces
- Uniform, constant rotary transmission even at extremely slow motion
- Acceleration control of the rotational axis using various ramps
- Directly coupled angle measuring system with high absolute accuracy



Broad Range of Applications Thanks to Versatile 3D Tracer Head

- Scanning 3D tracer head with digital measured value logging in all coordinate directions
- Parallel-deflecting system for constant measured value calculation even with extended probe elements
- Automatic specification of trace direction in the X/Z plane when measuring lead lines with contact operation in the normal direction
- Trace direction enabling for general 3D measurements
- Automatic compensation of different probe weights and adaptation of probe rods with multiple probe elements
- Automatic probe change (option)



Functional Accessories for Measuring Large and Heavy Workpieces (Option)

- Z measuring range up to 2,000 mm
- Face plates for holding ring-shaped workpieces in diameter increments of 1,500, 2,000, 3,000 mm – equipped with workpiece support and centering element
- Removable column with counterholder for workpieces up to 1,000 mm in diameter and a clamping length of 1,500 mm
- Permanently installed column with counterholder for workpieces up to 2,800 mm in diameter and with a clamping length of 2,500 mm
- Mobile unit for positioning the probing system on the workpiece



High Basic Accuracy with Low Tolerances

- Compensation for residual errors using special test equipment with software support
- Long-term stable geometry of all machine-mounted accessories and guide systems thanks to large size and use of high-quality materials
- Extremely smooth-running rotary tables even under load
- Use of length measuring/angle measuring systems in the highest accuracy classes
- Modern assembly system with low error rates based on pretested modules
- Constant measuring accuracies of all machine models

HIGHLIGHTS



Maximum Protection with Collision Protection

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



Industry-Compatible Calibration According to Recognized Standards

- Testing of all measuring centers with normals for profile and tooth trace and workpiece-like normals of different types and sizes
- Traceability of measuring results to internationally recognized normals (PTB)
- Proof of length measurement uncertainty U1 (option)
- Proof of system suitability for form measurement tasks (option)
- Determination of Cg/Cgk parameters (option)



Quick Availability of Measuring Results in Huge Time Savings

- Correction of measuring results for workpiece temperatures deviating from the reference temperature of +20 °C
- Recording the current workpiece temperature using a quick PT100 sensor
- Correction of the workpiece temperature in the range of +15 °C to +35 °C
- Algorithm usable for all metallic/rotationally symmetric workpieces



Fully Automatic Roughness Measurement

- Skid-mounted tracer head for measured value logging on gears with modules starting at 0.9 mm
- Output values acc. to DIN EN ISO 4287 (DIN 4762): R_a , R_z (DIN), R_t , R_{max}
- Tracing in the profile or tooth trace direction with standardized trace sections
- Fully automatic operation in connection with profile and tooth trace measurements
- Integrated actuator for diamond scanner alignment
- Probe systems for cylindrical and bevel gears
- Manual or (optional) fully automatic probe change



Versatile Measuring Tasks in One Setting

- Determination of measurement parameters such as diameter, length, angle, radius
- Determination of form and position parameters such as circularity, cylindrical shape, straightness, evenness, parallelism, symmetry, perpendicularity
- Measuring macros for checking keyways, curved washers and for checking bore reference circles
- Measured value chart output for form measurements with filter levels standardized to DIN EN ISO 1101
- Linking of dimension/form/length (DFL) measurements with gear measurements (cylindrical gear/bevel gear) for a continuous, fully automatic measuring cycle



Testing of Large Internal Gearing as well as Dimension, Form and Position Measurement in Bore Holes (W Machine)

- Angled measuring arm featuring 3D tracer head for immersion depths down to 800 mm
- Optimal probe situation for internal gearing measurements on gears with large tooth widths
- Optimal probe situation for high-precision dimension, form and position measurements, e.g. running surfaces for rolling elements on planet gears
- Automatic probe change rack (option)

USER-FRIENDLY SOFTWARE CONCEPT



Evaluation Software with Fully Automatic Measuring Cycles

Software plays a crucial role in the performance of the measuring device. It must be possible to test mandatory gear evaluation parameters according to the national and international standards or special requirements of large corporations. The measuring cycle is fully automatic. The CNC control transmits the measured values on-line to the measurement software, where the results are evaluated. During the measuring cycle itself, the program displays results on the screen and then prints all necessary information on easy-to-read measurement records, and can also store these locally or via a network.

- Intuitive user interface to Microsoft® Windows® standard – easy and secure operation with minimal training
- Function keys for fast measurement program creation
- Tree structure with direct access to all input levels
- Catalog of stored measurement programs with search function
- Measurement programs with additional image documentation on the workpiece clamping situation



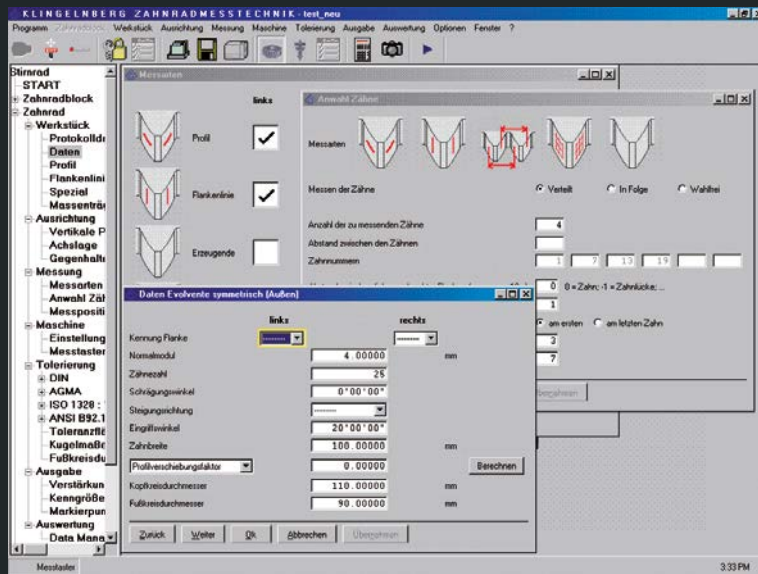
- Password protection for securing programming levels
- Repeat measurement evaluation without new measured value logging
- Individual choice of operator guidance/documentation language
- Application manager for selecting different software modules
- Linking of cylindrical gear/bevel gear/shaft measurement programs for a fully automatic process
- Various interfaces for further processing of measuring results

More information about Klingelberg software programs and modules is available in the in the special software folder

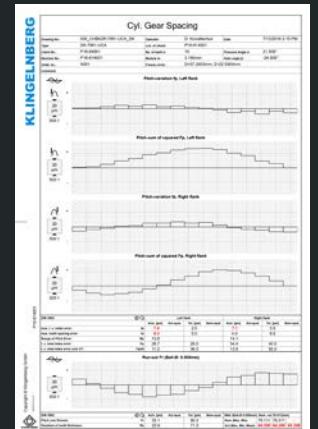
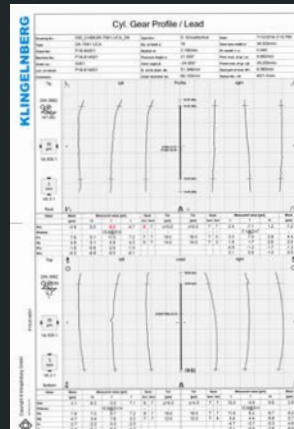


Due to the wide range of existing software solutions, we have only provided a selection here. Please feel free to ask for more options if required.

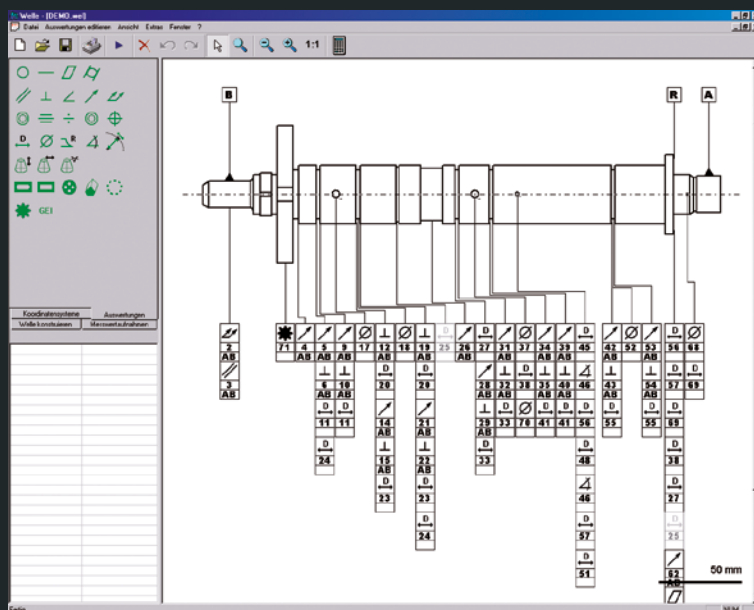
Cylindrical Gears – User Interface and Measurement Records



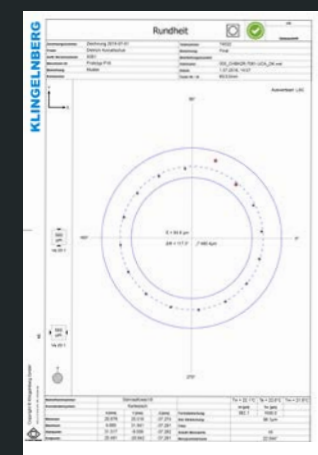
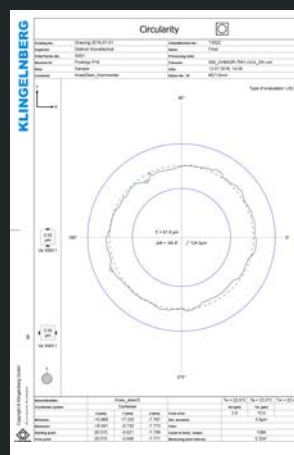
Easy, user-friendly interface with graphical elements



Dimension, Form and Position (Shaft) – User Interface and Measurement Records



Clearly arranged user interface showing measurement parameters



Drive Components Provide Optimal Performance with Guaranteed Quality

Special requirements are placed on the design of large and heavy-duty drive units. As a result, the drive should not only be as compact as possible, it should also be able to transmit high drive outputs. High-performance calculation programs are used for this, which allow requirement-based load cases to be simulated and computed accurately. The specifications determined in this way have to then be taken into account in component design and subsequently be created in the production process with low tolerance for variations.

Checking multiple quality characteristics simultaneously in a single setting is the significant advantage of modern gear measuring centers for large components. Along with determining the quality of the gearing according to recognized regulations and standards, surface check parameters for roughness or for grinding burn can be recorded as well. No less importantly, component measurements can also be carried out in general.

Typical application areas for large precision measuring centers include industries for generating power using wind power or turbo transmissions. Only drive components with assured quality and functional reliability are used for transmissions in marine applications for various uses or stationary mill drives as well, just to name a few examples.



Industrial Gear Units



The industrial gear unit sector is comprised of many different applications, all of which place great demands on the reliability of the drive units. The cylindrical gears for these sectors are often produced by companies specializing in small batch sizes and a variety of products. As a result, measuring centers with a wide range of applications and various workpiece sizes are required for quality assurance. It should also be possible to inspect every variety of gearing. P series precision measuring centers meet this requirement in full.

Maritime Propulsion Technology



The gearing used in shipbuilding must demonstrate great reliability and durability even under the most extreme external conditions. The wide range of component diameters requires extensive expertise for controlling the production process. Klingelberg's many years of experience and its certification by all major classification societies are the customer's guarantee of the utmost product quality, when using the precision measuring centers in the production process as well.

Wind Power



Only perfectly cut cylindrical and bevel gears can be used in wind power applications. This is because only perfectly ground gear geometry provides optimal transmission of force for highly efficient wind power installations while ensuring extremely quiet running behavior. High-precision gearing quality increases the service life of individual gear-box components, thereby significantly reducing maintenance costs. Klingelberg precision measuring centers make sure that the optimum gear geometry is maintained with high accuracy and that corresponding quality certification is provided.

Mining/Material Handling



Gear components used in material handling technology must withstand extremely challenging environmental conditions and service conditions. When used in belt drives, such as those used in brown-coal production, strong temperature fluctuations and vibrations are the order of the day. The toothed gears used in these transmissions are also subject to varying impact loads. As a result, robustness and load capacity are the most important requirements for these components. For particularly large gear teeth, the P 350 precision measuring center can handle toothed gears with outside diameters up to 4 meters.

Agriculture



In tractors, cylindrical and planetary gears are used in manual transmissions and countershaft transmissions as well as planetary gears to transmit power to the enormous drive wheels. Due to increasing requirements, these drives must be capable of transmitting increasingly large outputs within limited space. The cylindrical and planetary gears they use must be efficient, smooth-running, and low-maintenance. Therefore, the high measuring accuracy of the P series guarantees reproducible quality in mass production. As a result, products can be manufactured with the same quality throughout the world at different production locations.

TECHNICAL DATA

	P 200 [P 200 W]	P 300 [P 300 W]	P 400 [P 400 W]
Module range (min. – max.)	1 – 85mm	1 – 100 mm	
Helix angle or lead angle (min. – max.)	0° to 90°		
Workpiece diameter (max.)	2,000 mm	3,000 mm	4,000 mm
Permissible workpiece weight, approx. (max.) *12	20,000 kg	20,000 kg	30,000 kg
Horizontal measuring range [X axis]	±300 mm		
Vertical measuring range [Z axis]	1,200 (1,500 / 2,000) mm		
Workpiece supporting diameter, rotary table (min. – max.)	220 – 1,000 mm		
Machine Accuracy Gear Measurement VDI/VDE 2612 sheet 6 *6	Class A		
Machine Accuracy at + 18° C up to + 22° C			
Reference temperatures	0.5 K/h; 2 K/d; 0.7 K/m		
MPEE0 ISO 10360-2 (2010) *3/*4/*6	2.2 µm + L /250mm		
VDI2631 Radial angular deviation	0.5 µm		
Roundness Ø 100/L VDI/VDE2617-sheet 8 *4/*5/*6	0.6 µm		
Total axial runoutVDI/VDE2617-sheet 8 *4/*6	1.8 µm		
Total connected load of the machine	6.5 kVA		
Compressed air supply (accordance to ISO 8573.1 Class 5)	6 bar – 2 l/min		
Net weight including standard equipment, approx. *9	19,000 kg	21,500 kg (21,000 kg)	22,500 kg (21,500 kg)
Machine dimensions (L x W x H) approx.	4,217 x 2,600 x 4,070 (4,070 / 4,570) mm [4,217 x 2,600 x 4,570 (4,570 / 5,070) mm]	5,225 x 2,485 x 4,185 (4,185 / 4,685) mm [5,225 x 2,485 x 4,685 (4,685 / 5,185) mm]	5,385 x 2,485 x 4,185 (4,185 / 4,685) mm [5,470 x 2,485 x 4,685 (4,685/5,185) mm]

(Values in brackets are optional)

*3 Reduced shape in axis-parallel direction

*4 Use of the prescribed Klingelnberg stylus configurations respectively at Klingelnberg SFP Normal

*5 At turn table height

*6 Maximum permissible vibration speed, vertical, horizontal 0.1 mm/s peak to peak

*8 With increased measurement uncertainty

*9 Basic machine weight variations up to 10 %

*12 Starting approx. 20,000 kg workpiece weight, the maximum achievable axis acceleration is adapted to the increased mass moment of inertia

Subject to technical changes. The finish (color, design) can be taken from the offer.

KLINGELNBERG Service

The KLINGELNBERG Group is a world leader in the development and manufacture of machines for bevel gear and cylindrical gear production, and precision measuring centers for gearing and axially symmetrical components, as well as 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.

The company also maintains a presence with Sales and Service offices and numerous marketing agents. 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.

EN 10/2023 - Subject to technical modifications without notice.

FOLLOW US AND STAY UP TO DATE:



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