

OERLIKON

G 35

BEVEL GEAR TECHNOLOGY – GRINDING MACHINES



KLINGELBERG

A LEADER IN BEVEL GEAR TECHNOLOGY

Intelligent Solutions for Discerning Users

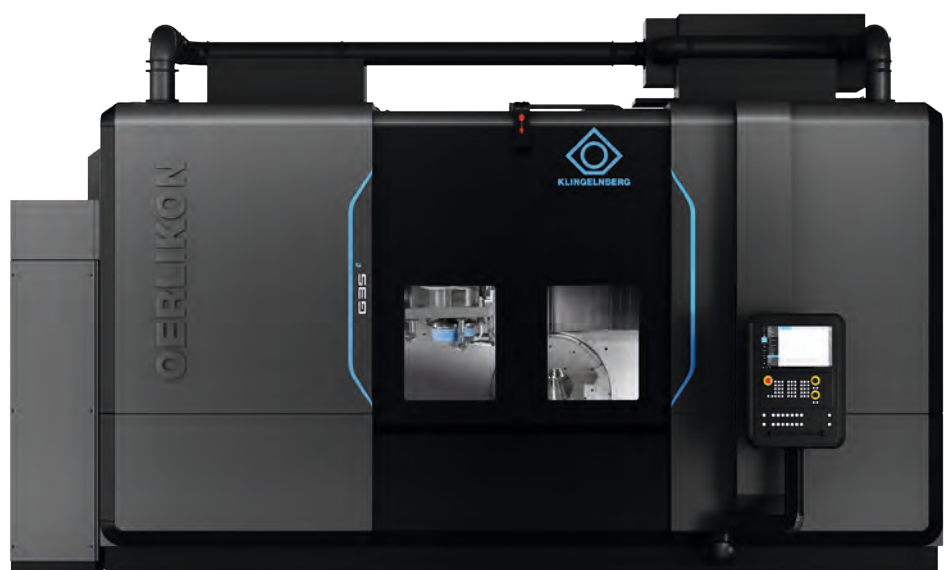
Around the world, manufacturers of gears and gearboxes ensure their leading edge in gear machining with innovative solution concepts from Klingelberg.

The **Oerlikon Bevel Gear Technology** division does not just allow users to manufacture bevel gears economically and with high precision. All machines in the system have been designed to work together to enable pre-machining and finishing of even the most complex gears.

Klingelberg offers the most advanced technology and the most efficient machines for each and every step in the process chain. The production process chain for bevel gears includes **tool preparation, cutting, measuring**, hardening, **grinding or lapping** and **testing**, among others. The powerful **KIMoS (Klingelberg Integrated Manufacturing of Spiral Bevel Gears)** design software and the **Closed Loop concept** ensure transparency and documented quality throughout the entire process chain.

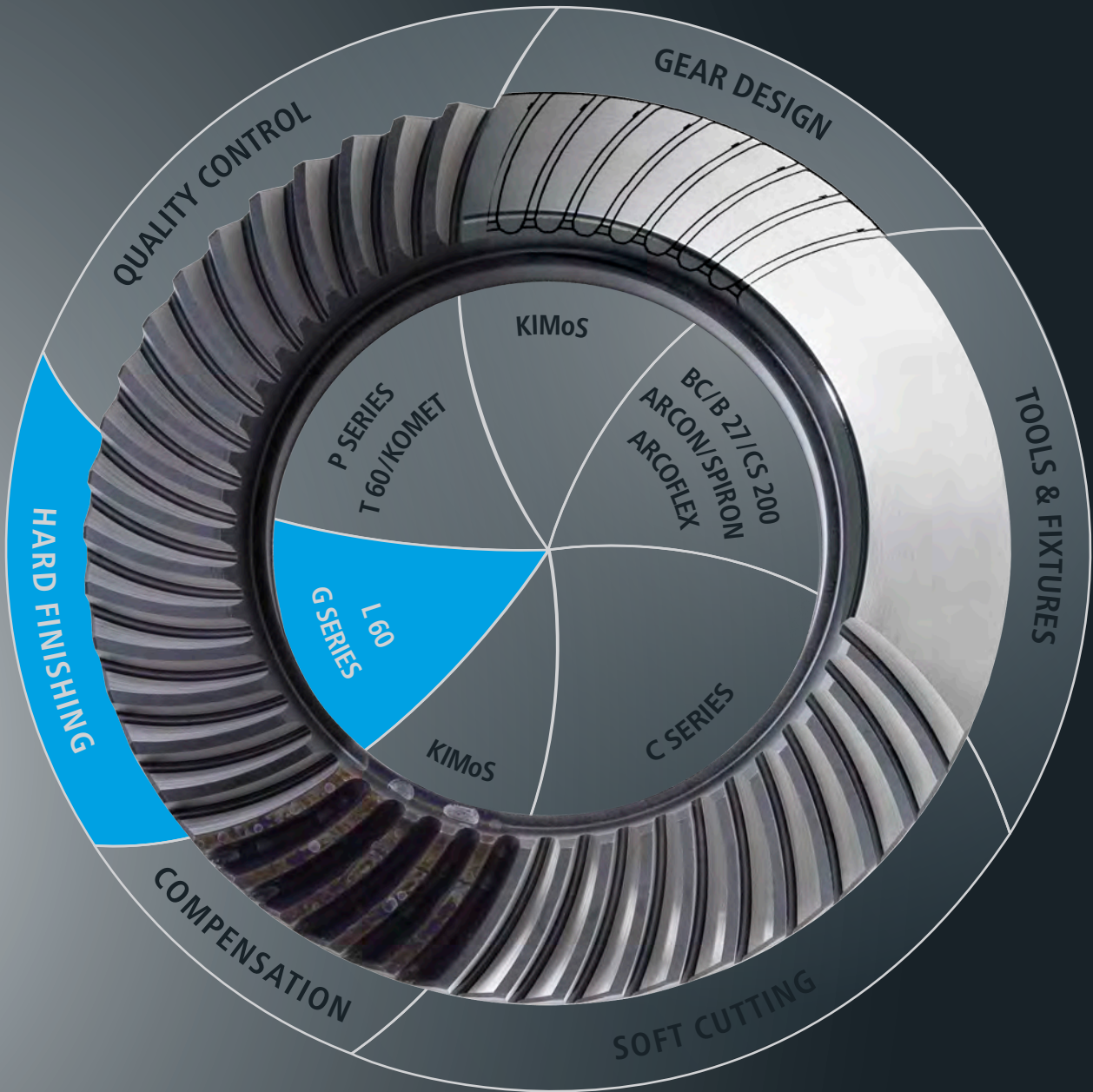
Oerlikon bevel gear machines are developed with real-world applications in mind and meet the varying demands of a whole range of industries. The target markets include the automotive industry, commercial vehicle industry, agricultural industry, ship-building and aviation, as well as industrial gearbox manufacturing and industrial engineering.

As a leading system supplier and in combination with these high-performance tool systems, Klingelberg meets every requirement for flexible, efficient production — for the smallest and the largest batch sizes.



Oerlikon G 35 bevel gear grinding machine with numerous equipment details

Exceptional Concepts for Every Process Step in Gear Technology

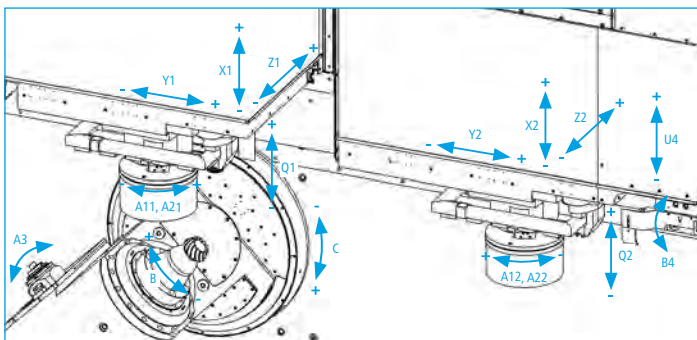


Leading-Edge Technology for Optimal Flexibility and Maximum Productivity in the Aviation Industry

Specifically tailored to the requirements of the aviation industry, the Oerlikon G 35 bevel gear grinding machine takes aviation gear manufacturing to a new level with its two vertical grinding spindles. Tried and tested concepts and components were used to ensure optimal functionality and the best possible availability of spare parts for this special-purpose machine. The proven technology has been enhanced to include new functionalities that allow for efficient work practices on the machine. The machine's basic concept is based on the current Oerlikon G 30 single-spindle machine. Owing to its high rigidity and thermal stability, this machine achieves optimal machining results in the automotive industry, even in highly productive processes.

The G 35 is equipped with two grinding heads that can be positioned independently, allowing pinions, for example, to be machined using the fixed setting method, in which the convex and concave tooth flanks are machined with different tools in a fixed setting. Unlike older dual-spindle concepts, the G 35 presents no additional collision contours that limit the operation of the machine, thanks to the second grinding head. To ensure rapid positioning of the grinding heads, they are equipped in the main direction of motion (Y1 and Y2) with highly dynamic linear motors, whose design has already been proven in the larger G series machines (G 60 and G 80). All of the bevel gear machines in the G series are equipped with a thermostable, vibration-damping machine bed. The axis concept ensures a rigid design of the complete machine.

- Two independently positionable grinding heads enable easy set-up and maximum flexibility
- Extremely rigid and thermally stable machine for optimal machining results, even in highly productive processes
- “Clean cabin concept” eliminates grinding sludge deposits in the working chamber
- Innovative operating concept with intuitive touch screen navigation
- Optimal energy efficiency (e²) thanks to recovery and on-demand control of units



Axis arrangement of an OERLIKON G 35 bevel gear grinding machine

CNC axes:

A11 Grinding spindle left
 A12 Grinding spindle right
 A21 Eccentric spindle left
 A22 Eccentric spindle right
 B Workpiece spindle
 C Base angle setting

Q1 Cooling lubricant adjustment axis left
 Q2 Cooling lubricant adjustment axis right
 A3 Dressing spindle
 B4 Deburrer rotational axis
 U4 Deburrer linear axis
 X1, Y1, Z1, X2, Y2, Z2 Linear axis

One Machine, Two Spindles: Vertical Machine Designed to Meet Aviation Industry Requirements

Dressing



- Custom grinding wheel profiling and conditioning

Deep grinding



- Soft cutting of bevel gears for prototype and small-lot production

Deburring



- Precise abutting face deburring of deep ground components in the same setup (optional)

Finish grinding



- Hard finishing of bevel gears to the highest standards of quality and productivity

Quality assurance



- Gear and stock removal measurement to document the production process with the optional KOMPASS measuring device

Complete Machining of Aircraft Bevel Gears on One Machine

The dual-spindle machine enables machining of both pinion flanks in a fixed setting. This results in optimal concentricity of the gearing and allows the local stock removal to be determined for both tooth flanks in one step. Example:

- **Soft cutting:**
Deep grinding of convex tooth flank with spindle A11 and concave tooth flank with spindle A12, as well as deburring on the abutting face with spindle B4
- **Finish cutting:**
Measurement of starting topography of gearing with KOMPASS; final grinding of convex tooth flank with spindle A11 and concave tooth flank with spindle A12; measurement of topography and local stock removal for both tooth flanks with KOMPASS

High-Tech Can Also Be Simple!

“Simplified with Passion” – true to this motto, Klingelberg is driven to provide simple, unconventional solutions to high-tech challenges. A team of engineers and technical experts makes it possible — always with the goal of ensuring the highest technological standards in application-matched machine designs that are also easy to use.

Case in point: the Oerlikon G 35 bevel gear grinding machine is based on established development concepts that are optimized on an ongoing basis. Klingelberg’s success factors include:

- High productivity with the lowest possible per-piece costs and maximum process safety
- Unique Closed Loop concept for the entire bevel gear machining process chain
- Comprehensive service offering with a broad service network
- Outstanding technical expertise and expert knowledge, which Klingelberg passes on to customers in professional seminars



Oerlikon G 35 bevel gear grinding machine for workpiece diameters up to 350 mm



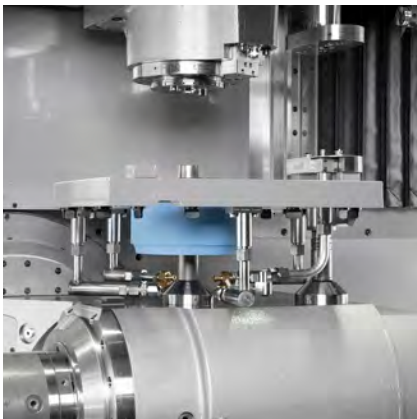
Vertical Machine Concept for Reliable Process Sequences

- Vertical grinding spindles for optimal chip removal
- Excellent visual process monitoring capability during process positioning, thanks to an optimal machining position of the vertical grinding spindles
- Component and clamping device change option “with gravity” in the vertical direction
- Smooth surfaces and minimal interference contours in the working chamber combined with efficient interior cleaning to eliminate grinding sludge deposits (optional)



Dual-Spindle Concept for Machining with Two Grinding Wheels

- Aircraft gearings produced by the 5-cut method in a fixed setting for optimal gear concentricity
- Use of separate grinding wheels for roughing and finishing enables highly productive grinding of duplex gearings with ultra-high quality surface finishes
- Two independently positionable grinding heads for maximum flexibility, collision-free operation, and easy set-up
- Grinding head positioning with highly dynamic linear drives minimizes auxiliary time



Minimal Retooling and Configuration Times

- Simultaneous, automatic set-down and pick-up of grinding wheel and oil ring for fast tool changes
- Fully accessible working chamber through front service door
- Two dressing position options on the grinding wheel periphery provide greater flexibility for optimal adjustment of the cooling nozzles
- Efficient grinding wheel preprofiling and reprofiling with special dressing software



Maximum Process Reliability with Continuous Monitoring

- Automatic contact detection for dressing with AE sensor (optional) enables minimal dressing amounts without risk of profile loss
- Air gap control (optional) to ensure correct component seating for automatic loading
- Allowance check for time-neutral detection of improperly machined components
- Grinding power monitoring with emergency retraction for automatic stopping of the machine in the event of a sudden power increase

HIGHLIGHTS



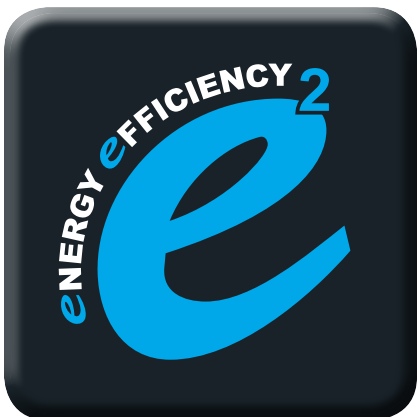
Machine-Integrated Start-Up and Quality Assurance (Optional)

- Measurements in the machine during the production process itself ensure that production goes quickly
- Topography measurement before and after machining to document stock removal
- Automated correction calculation in the machine for maximum precision from the first component
- High indexing accuracy requires no in-depth user know-how



“Single-Piece” Grinding Oil Supply

- Nozzles for process cooling and cleaning mounted on a removable single-piece element (oil ring) ensure optimal reproducibility of the grinding oil supply
- Automatic oil ring change (optional)
- Innovative, high-pressure-resistant telescope system for quick and easy adjustment of the grinding oil supply with minimal tool requirements for shorter retooling times
- Fully leak-proof system for maximum process cooling efficiency
- Constant machining conditions thanks to automatic adjustment over the grinding wheel service life



Energy Efficiency (e²) for the Most Stringent Demands

- Energy-saving cooling technology thanks to effective control of the cooling units
- High energy-efficiency-class drives
- Intelligent reactive current compensation
- Efficient energy recovery

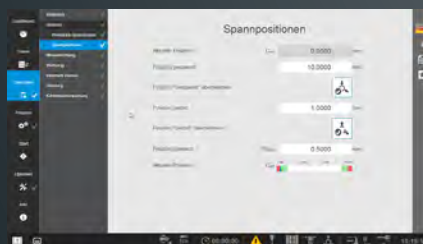
Intuitive Operating Concept with Trend-Setting Touch Technology

1 Multilingual menu navigation allows for worldwide use

2 Menu navigation is easy and requires minimal training thanks to innovative workflow support

3 Input errors are avoided by the intelligent warning function preventing costly incidents or even accidents

4 Machine configuration is successfully completed in just a few steps

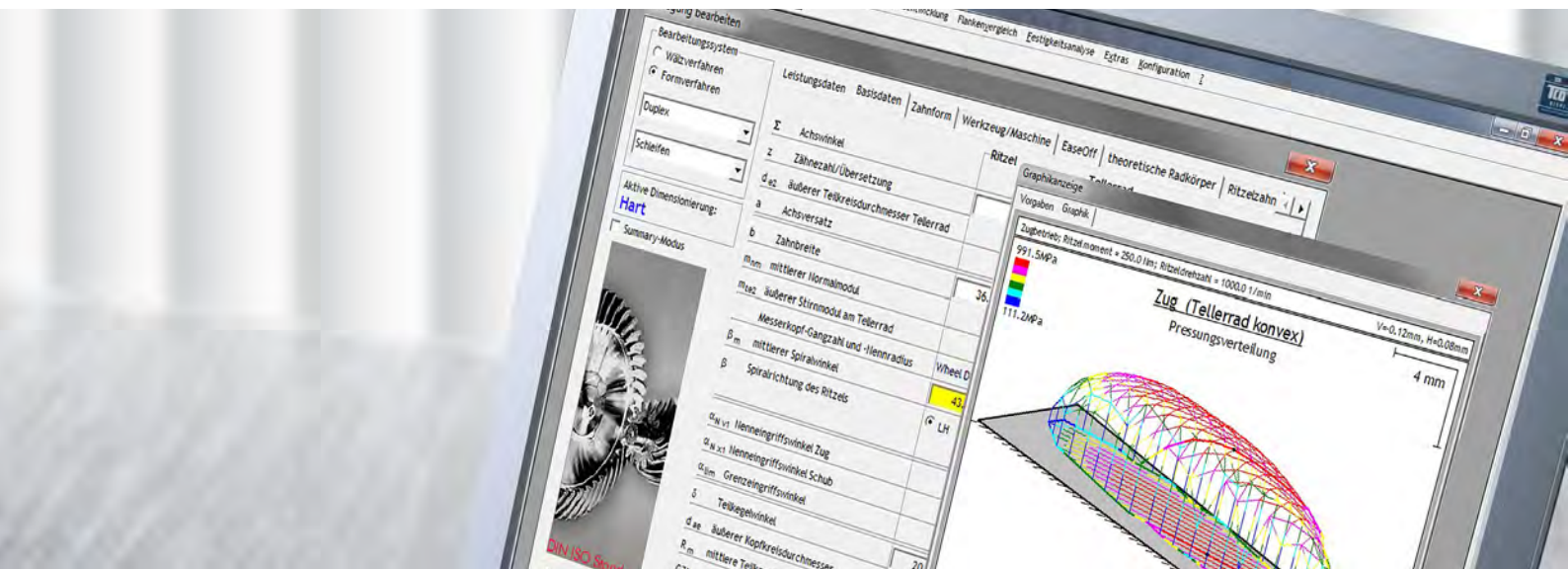


5 High production reliability ensured by visualization of the production workflow in real time (dashboard)

6 Fast, easy control of all program functions in a single graphical user interface

7 Easy-to-read display of current consumer data places the focus on energy efficiency

GEAR DEVELOPMENT BASED ON NOMINAL DATA



Design and Optimization of High-Performance Bevel Gear Sets

The **KIMoS** (Klingelberg Integrated Manufacturing of Spiral Bevel Gears) software package supports every step in bevel gear design and optimization. **KOMET** measures corrections for machine settings and any tool data to minimize measured variations on the ground flanks.

As part of this process, all necessary data for the gear cutting process, tool preparation and quality control of the bevel gears to be produced are prepared in parallel. Convenient data handling provides a way to both make use of freely definable development databases in the development phase and to make production-approved data from the production database available to the production and measuring machines used in the process. The software package thus provides the optimal basis for ultra-modern bevel gear production according to the Closed Loop method: **The end result precisely matches what was previously designed and optimized on the computer.**

A modular program package, KIMoS provides the user with the whole range of functionality needed to create application-appropriate gear designs for specific applications. All common gear cutting processes, machines and tool systems are supported.

Among the integral components of KIMoS are a gear-cutting optimization feature with easy-to-operate dialogs, analysis of the expected operation behavior of the gearing, and evaluation of the results with a load-capacity and strength calculation.

For gear design, KIMoS provides:

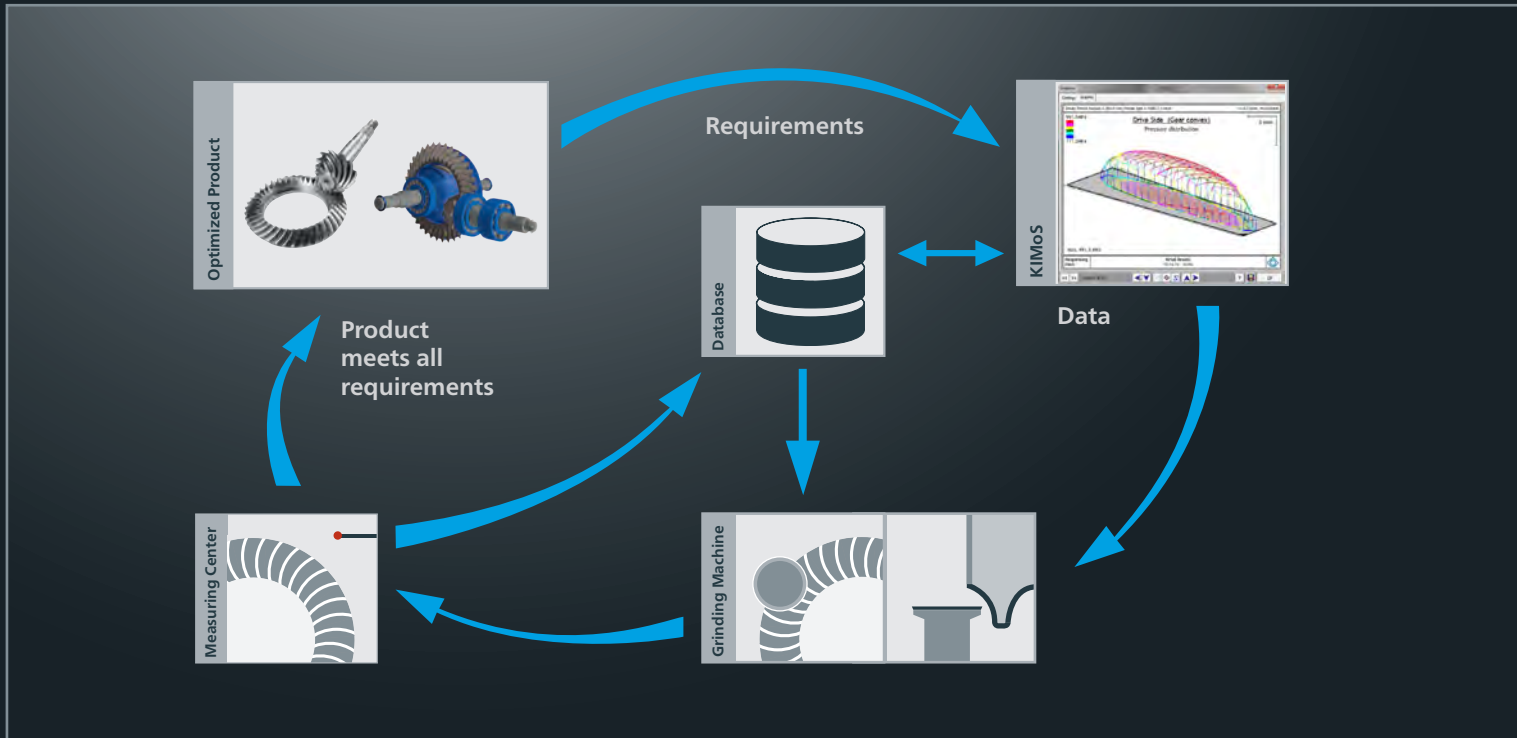
- Independent design with individual production possibilities taken into account
- Cultivation of expertise within the company as a competitive advantage
- Fast, accurate analysis of testing and production results and gear damage

For gear production, KOMET provides:

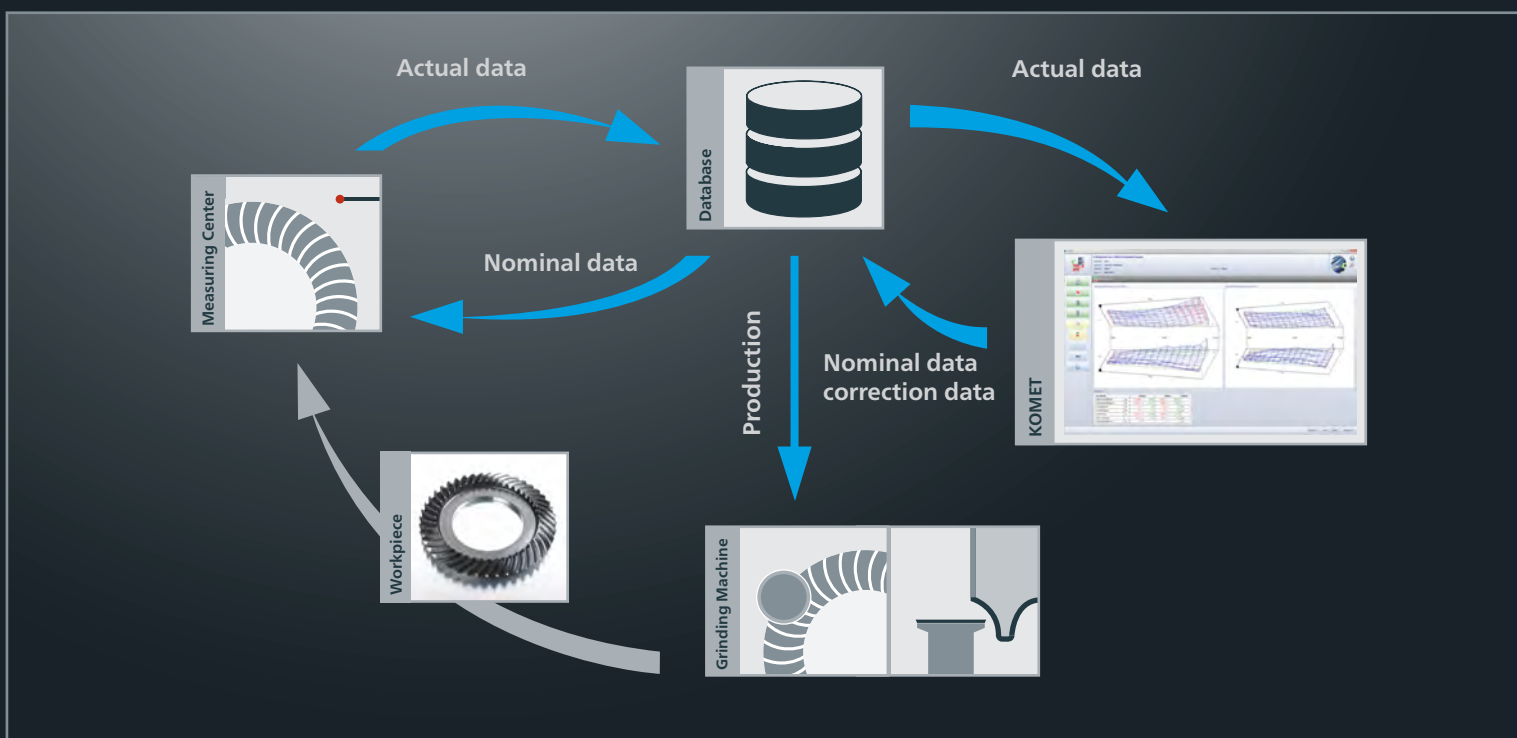
- Reliable calculation of correction data immediately following gear measurement
- Machine-specific correction data for bevel gear production
- Maximum process safety by interfacing with the Klingelberg database

Advanced Bevel Gear Production in a Unique Closed Loop Process

KIMoS – for Optimal Design



KOMET – from Design to Optimal Production Result



Drive Components with Guaranteed Quality Provide Optimal Performance

In countless industries, Klingelberg solutions have become a fixture in the international market. To meet market requirements for high productivity in mass production and flexibility in small-batch production, Klingelberg offers a range of solution concepts for just about any requirement.

Used throughout the world, the “Simplified with Passion” system plays an important part in ensuring that machine tasks are made simple. Moreover, the Klingelberg system contributes to standardization and quality assurance on a global scale.



Automotive



In cars, spiral bevel gears are used in all-wheel-drive systems and rear-wheel-drive systems to transmit torque "from the transmission to the road". Due to increasing performance requirements, these drives must transmit outputs of over 300 kW in some cases. The bevel gears they use must be efficient, smooth-running, and low-maintenance. Reproducible quality in standard production with the fastest possible production times are key requirements in this industry.

Commercial Vehicles



Commercial vehicles are always rear-wheel-driven. The bevel gear sets they use must transmit power in the range of 500 kW – at extremely high torques. This places high demands on durability and strength. The bevel gears must be efficient, rugged and low-maintenance. Use of the integrated Klingelberg system makes it possible to mass-produce bevel gears with the quality required.

Industrial Gear Units



The industrial gear unit sector comprises many different applications, all of which place great demands on the reliability of the drive components. The bevel gears for these sectors are often produced by companies specializing in small batch sizes and a variety of products. A rigid machine design and flexible, cost-effective tool systems are the keys to success for ranking among the market leaders in these sectors.

Aviation



Bevel gears used in airplanes must embody the highest quality in terms of pitch and runout (DIN 1–3) and must also execute rotational movements with absolute reliability. Just as important are other geometrical features such as surface quality, root geometry, rotational error, high strength and low weight. Frequently used in this industry are special materials, which place extreme demands on tools and processes.

Maritime Propulsion Technology



The bevel gears used in shipbuilding must demonstrate great reliability and durability even under the most extreme external conditions. The high range of component diameters (up to 2 m) requires extensive bevel gear know-how to master 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.

Agriculture



In agricultural applications such as tractors, spiral bevel gears are built into the rear axles. Harvesters and hay machines use straight bevel gears to enable the corresponding functions. Whereas the bevel gear set in a tractor rear axle drive must transmit up to 400 kW, the loads on straight bevel gears are comparably low. The most important market requirement for straight bevel gears is a modern production and a cost efficient solution.

TECHNICAL DATA

G 35

Workpiece data		
Workpiece diameter (max.)	Ø 300 (350)* mm	
Normal module range (min. – max.)	0,7 – 8 mm	
Face width (max.)	60 (70)* mm	
Number of teeth (max.)	360	
Basic angle setting range	±90°	
Tool data		
Grinding wheel diameter (min. – max.)	32 – 114 mm (1,25 – 4,5")	127 – 355 mm (5 – 14")
Grinding wheel height incl. base plate (max.)	110 mm	135 mm
Tool spindle		
Seat	HSK-E50 E DIN 69893-5	
Grinding spindle rotation speed (max.)	8,000 (12,000)** rpm	
Eccentric speed (max.)	3,800 rpm	
Dresser speed (max.)	10,000 rpm	
Nominal grinding wheel drive rating	14 (22)*** kW	
Workpiece spindle standard		
Seating diameter: Oerlikon outer cone 1:4	Ø 140.11 mm	
Seating diameter: inner cone	Ø 99.258 mm (3.9")	
Work spindle bore	Ø 93 mm	
Work spindle depth	280 mm	
Workpiece spindle rotation speed (max.)	1,500 rpm	
Workpiece spindle optional		
Seating diameter: Oerlikon inner cone	Ø 128.224 mm (5 3/64")	
Work spindle bore	Ø 120 mm	
Work spindle depth	290 mm	
Workpiece spindle rotation speed (max.)	1,500 rpm	
General machine data		
Total connected load without filter system	55 kVA	
Machine dimensions including filter system approx. (L x W x H) ****	6,550 x 6,220 x 3,980 mm	
Machine net weight without filter system approx.	37,500 kg	

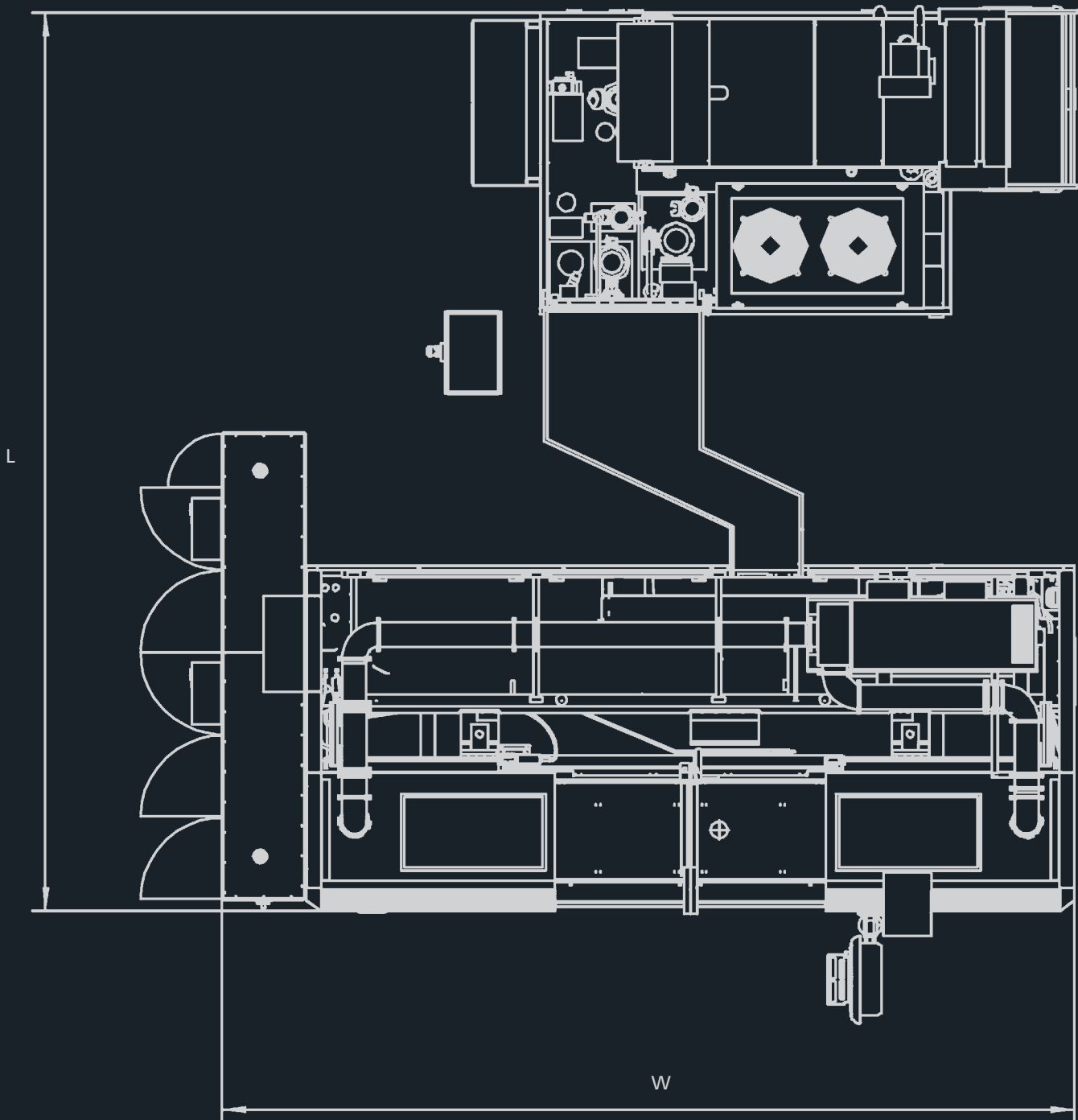
The above-mentioned maximum values were determined for industry-typical gear units. Further testing may be required to determine whether maximum values can be combined.

*/**/*** Option (options cannot be combined)

**** The dimensions of the standard version are for orientation only. Swivel ranges for doors, operating panels etc. are not taken into account here. The final space requirement depends on the individual configuration of the machine.

Installation Dimensions

G 35: Top View, incl. Filter System



All specifications in mm

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.

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FOLLOW US AND STAY UP TO DATE:



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 5-9
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/kontakt