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WELTER zahnrad

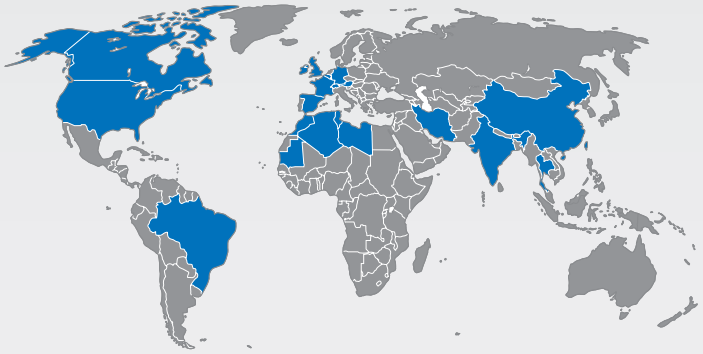
Innovative drive technology

About us

Innovative drive technology – all over the world

WELTER zahnrad is the global contact partner for innovative drive systems. The company was founded by Richard Welter in 1946 and has continuously grown ever since. As a result, we are technologically and financially stable. Our mission statement of offering our customers the maximum benefit through „utmost quality and performance“ is our complete priority.

We have become specialists in the manufacture of individual parts as well as small and medium-sized batches with our gear wheel production. In doing so, our qualified and motivated workforce enables us to cater to the most diverse customer requirements and also meet special requirements placed on product quality, construction and design. We also believe that seamless traceability is extremely important. We procure raw material in accordance with the strictly defined in-house WELTER standard. Our suppliers are carefully selected and constantly evaluated. We are internationally certified in accordance with the ISO 9001:2008 series of standards for quality management.



Furthermore, our quality management system is certified in accordance with EN 9100:2009 for deliveries in the aviation segment.

With the assistance of extensive software packages, our experienced application engineers can either support you in designing gearboxes or do it on your behalf. WELTER zahnrad supplies internally developed individual parts, gear sets as well as complete internal part sets (e.g. vertical mills or locomotive drives) through to complete gearboxes (shredders, conveyor belts pumps, cement mills, cages). We are continuously developing in to a system supplier in the drive engineering segment through the constant expansion of our Development and Application Engineering Departments.

Some of our services here include:

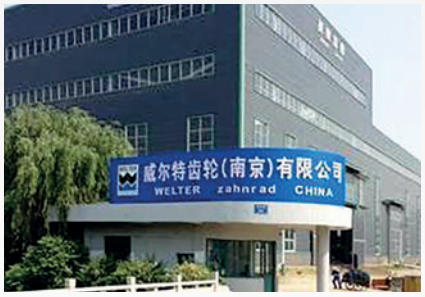
- *Customer support during the production and application-oriented design of the gear wheels (material selection, hardness process, dimensioning, tolerances).*
- *Support and implementation of service tasks through to condition monitoring.*
- *Spare part production, reduction of standstill.*
- *Re-engineering of gear wheels through to the production of entire gearboxes.*
- *Development and construction of complete gearboxes.*

Maximum end customer benefit is achieved thanks to the WELTER zahnrad Integrated Service Approach. This is made possible through clear organisational structures, technically trained Sales employees in Europe and through carefully selected and trained representatives overseas.

We manufacture at two locations in Lahr/Black Forest (Germany) and Valff/Alsace (France). We market, develop, assemble and supply worm gearboxes with the superior CAVEX® concave flank geometry at CAVEX GmbH & Co. KG in Ofterdingen, a subsidiary in which we hold a majority stake.

Our joint venture in Lishui, close to Nanjing, China is a sales and service base for our company. Gearboxes can be disassembled and the components can be measured on site to allow the reproduction of components for repair purposes.

WELTER zahnrad GmbH
Lahr/Black Forest



WELTER zahnrad China Works
Nanjing, China

SPIROTEC S.A.R.L.
Valff, France

CAVEX GmbH & Co. KG
Ofterdingen

Segments

Tailor-made solutions

Our comprehensive and modern production facilities enable almost every customer requirement to be met during the production of gear wheels. This is rounded off with precisely defined processes as well as testing and measuring equipment. As a result, we are a supplier for all challenging applications in the machinery and plant construction segment as well as in the field of transport.

In addition to the production of the complex components, we support our customers in the engineering segment and also supply assemblies and gearboxes on request.

Tram drives

- Bevel gear sets
- Spur gears/Helical gears
- Face couplings
- Hirth couplings
- Sample part production

Rolling Stock

- Bevel gear sets
- Spur gears/Helical gears
- Face couplings
- Hirth couplings
- Sample part production

Cable cars

- Bevel gear sets
- Spur gears/Helical gears
- Herringbone gears
- Hirth couplings
- Face gears
- Sample part production

Construction machinery

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Sample part production

Motorsport / vintage cars

- Bevel gear sets
- Spur gears/Helical gears
- Beveloid gear sets
- Plane gear sets
- Sample part production

Aviation

- Bevel gear sets
- Spur gears/Helical gears
- Polygons
- Special profiles

WELTER
zahnrad

Steel industry

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Sample part production
- Development & construction

Energy industry

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Herringbone gears
- Sample part production
- Gearbox overhaul
- Development & construction

Mining / conveying

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Sample part production
- Gearbox overhaul
- Development & construction

Marine engineering

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Sample part production
- Gearbox overhaul
- Development & construction

Machine tools

- Bevel gear sets
- Spur gears/Helical gears
- Plane gears
- Hirth couplings
- Internal gears
- Development & construction

Pump industry

- Spur gears (also manufactured from stainless steel)
- Herringbone gears (also manufactured from stainless steel)
- Sample part production

Presses

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Herringbone gears
- Sample part production

Agricultural machinery

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Hirth couplings
- Sample part production

Cement industry

- Bevel gear sets
- Spur gears/Helical gears
- Internal gears
- Herringbone gears
- Sample part production
- Gearbox overhaul

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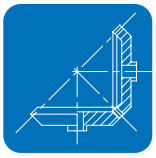


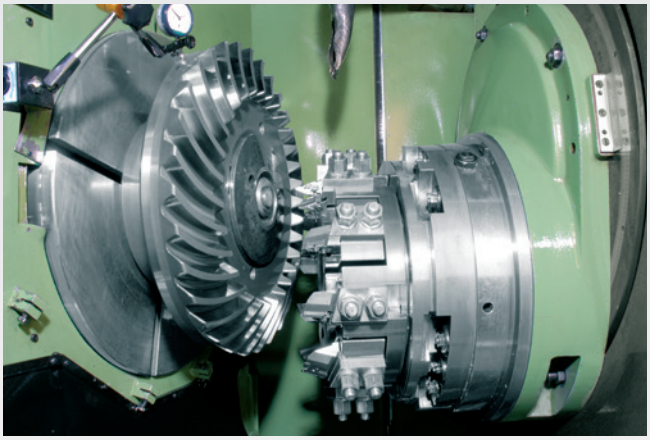
Bevel gear sets

Quality and diversity

Spiral toothed bevel gear sets have prevailed in many segments as they offer great accuracy, high levels of torque and smooth running. WELTER zahnrad produces bevel gear sets in all conventional gearing versions, a wide module range and in high grades. We are happy to lend our experience and latest calculation methods in order to support you during the design phase, e.g. when designing low-noise gear sets. The gearing quality is monitored and documented during the process.

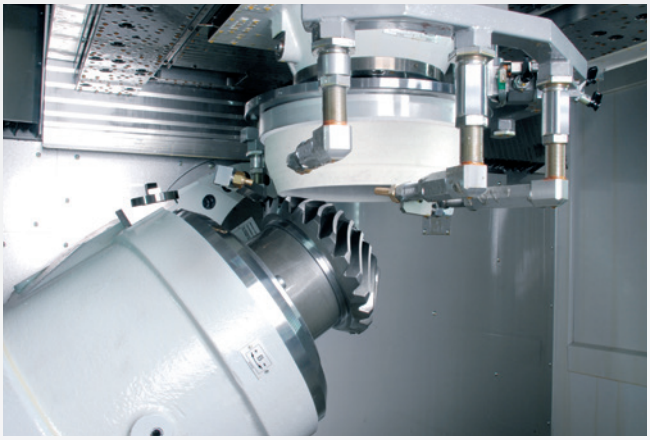
	Klingelnberg palloid	Klingelnberg Cyclo palloid	Klingelnberg HPG-S	Curvex	Oerlikon, ground	Gleason, ground	5-axis hard-milled	Straight tooth
Normal module	1 - 4.5	1 - 20	4 - 20	1 - 10	1 - 12	4 - 12	1 - free	4 - free
Pressure angle	20° (17.5°/22.5°)	20° (17.5°)	20°	20°	20°	20°	As desired	----
Number of teeth	6 - 60	6 - 120	6 - 120	6 - 120	6 - 120	6 - 120	6 - free	6 - free
External diameter	<300mm	<1400mm	<1400mm	<650mm	<800mm	<800mm	<2800mm	<2800mm
Wavelength	<500mm	<1800mm	<1800mm	<900mm	<900mm	<900mm	<2000mm	<2000mm
Shaft angle	45 - 135°	45 - 135°	45 - 135°	45 - 135°	45 - 135°	45 - 135°	3° - 160°	3° - 160°
Tooth width	<60mm	<180mm	<180mm	<100mm	<150mm	<150mm	Free	Free
Quality DIN 3965	8 - 9	7 - 9	5 - 6	7 - 9	4 - 5	4 - 5	5 - 6	5 - 6
Material	Case-hardening, nitriding and tempering steels, casting, plastics, stainless steels							
Heat treatment	Case-hardening, nitriding, inductive-hardening, annealing							
Options	Spline shaft and hub profiles according to DIN ISO 14, spline shaft profiles according to DIN 5480 and similar, polygons, spur gears Hirth gearings, shot blasting, coating (e.g. Balinit), balancing according to DIN ISO 1940, G1.6							

HPG bevel gear set with spline shaft profile DIN 5480



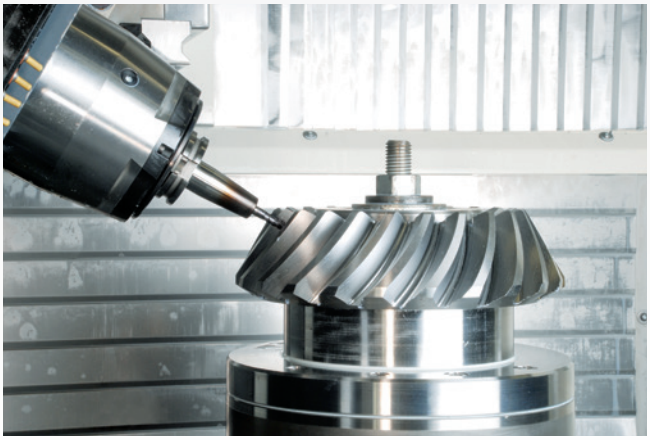
HPG process / hard machining - max. Ø: 1400 mm

Beveloid gear set



Bevel gear grinding - max. Ø: 900 mm

Ground bevel gear set



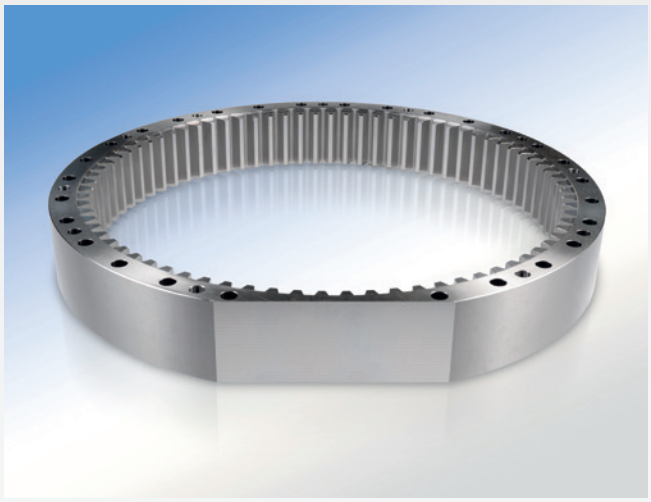
Five-axis CNC milling - max. Ø: 2800 mm

Spur gears and helical

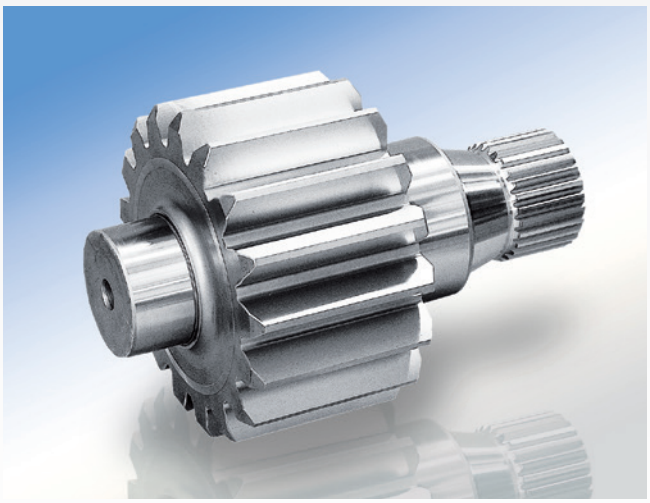
Internal and external gearing

We produce spur gears in all conventional gearing versions, tooth shapes and to high grades. Our extensive and modern machine pool allows us to economically produce gear wheels using processes such as hobbing, gear cutting and free-form milling. In order to achieve high quality on hardened gears, they can either be ground or hard-milled on modern machinery. Quality assurance is performed continuously during the process and is documented in the gearing record by means of 3D measurement as part of the final inspection.

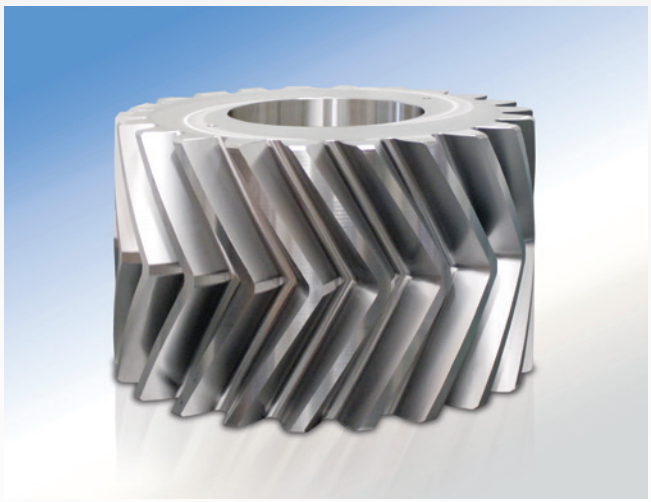
Spur gear for locomotive drive



Ground ring gear



Highly-stressed pinion for tunnel boring machines



Real herringbone gear

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Spur gear grinding up to d=2000mm

Flexible processing cells with robot assembly and 370 tools

	Straight gearing	Helical gearing	Herringbone gearing	Real herringbone gear	Ring gear
Module	2 - free	2 - free	2 - free	4 - free	4 - free
Production	Gear cutting Hobbing Free-form milling	Gear cutting Hobbing Free-form milling	Gear cutting Hobbing Free-form milling	Free-form milling	Gear cutting Free-form milling
Hard machining	Grinding Hard-milling	Grinding Hard-milling	Hard-milling	Grinding Hard-milling	Grinding Hard-milling
Quality DIN 3961-63	3 - 9	3 - 9	5 - 9	3 - 9	5 - 9
Diameter	<2800mm	<2800mm	<2800mm	<2800mm	300 - 2000mm
Wavelength	<25,000m	<25,000m	<25,000m	<25,000m	----
Shaft angle	170° - 190°	180°	180°	180°	170° - 190°
Helix angle	----	50° - 130°	50° - 130°	50° - 130°	50° - 130°
Material	Case-hardening, nitriding and tempering steels, casting, plastics, stainless steels				
Heat treatment	Case-hardening, nitriding, inductive-hardening, annealing				
Options	Spline shaft and hub profiles according to DIN ISO 14, spline shaft profiles according to DIN 5480 and similar, polygons, spur gears Hirth gearings, shot blasting, coating (e.g. Balinit), balancing according to DIN ISO 1940, G1.6				

Face gearing

Self-centring couplings

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Hirth couplings and face couplings in accordance with Klingelnberg, Gleason or Oerlikon permit the clearance-free, self-centring and exceptionally highly durable connection of units. Thanks to the geometry, the repeatability is excellent. Depending on the geometry, the face gearing is produced on gear cutting machines for bevel gears using special blades in a gear hobbing process or by means of 5-axis milling. In order to meet the high quality requirements, the gearings are ground or hard-milled after the hardening process. The parts are examined indirectly by die-spotting two coupling elements and measuring the distance or by means of 3D measurement.

Hirth couplings

Klingelnberg face coupling

	Hirth gearing	Klingelnberg	Gleason	Oerlikon
Diameter	<800mm	<600mm	<600mm	<600mm
Part height	<800mm to Ø800mm <1200mm to Ø125mm	<1000mm	<1000mm	<1000mm
Number of teeth	48 - 720	12 - 80	12 - 80	12 - 80
Material	Case-hardening, nitriding and tempering steels			
Heat treatment	Case-hardening, nitriding, inductive-hardening, annealing			
Options	Triple Hirth rings with jointly ground inner/outer ring			

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Face gears

New possibilities

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Face gears are utilised in angle gearboxes and are meshed using one or several straight or helically toothed spur gear pinions. In the past, they were ousted by bevel gears due to the available production options. Thanks to modern production machinery and the process optimisation which has taken place at our company, it is now possible to produce face gears to Quality Level 5 in accordance with DIN 3961-63.

The advantages include:

- *Any shaft angle between 0-150° possible*
- *The axial mobility of the pinion enables simple assembly as well as a constant wear pattern under load*
- *Easy to adjust triple sets (differential)*
- *Ratio up to i = 20*
- *Layout with axial offset*
- *Excellent effectiveness, comparable with a spur gearbox*
- *Three-component Bevel gear-spur gear combination possible*
- *Insensitive to temperature*
- *No / extremely low axial forces with straight-toothed pinion*
- *Separate production of the plane gear and pinion possible, no pairing necessary*
- *Wear-free across the entire service life*

Specifications	
Material	*Case-hardening, nitriding and tempering steels, casting, plastics*
Heat treatment	*Case-hardening, nitriding, inductive-hardening, annealing*
Options	*Spline shaft profiles according to DIN 5480 and similar, polygons, Hirth gearings, shot blasting, coating (e.g. Balinit), balancing according to DIN ISO 1940, G1.6*

Face gear

Nitrided face gear set, 135° axial offset

Tempered face gear set

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Worm gear sets

Customer-specific production

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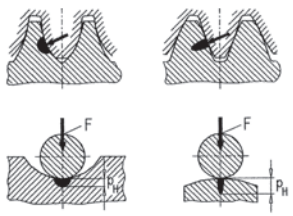
We produce worm gear sets according to customer drawings with all conventional standard profiles. In addition to the customary production using hobbing millers, we also produce special designs by means of free-form milling.

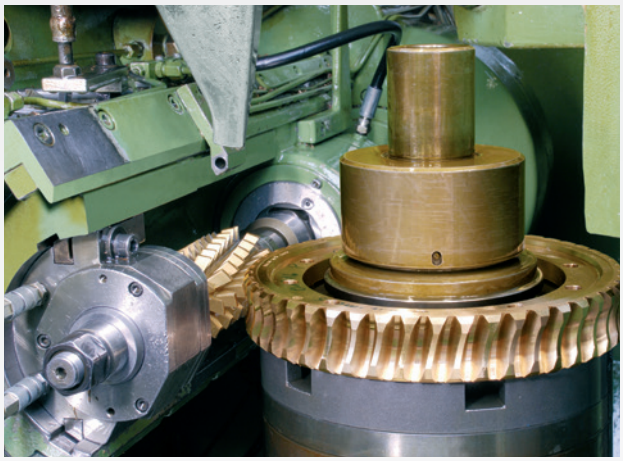
We offer worm gear sets with a CAVEX® profile through CAVEX GmbH & Co KG. Thanks to the concave flank profile, the premium bronze material properties of the worm gear in combination with the case-hardened and ground worm are fully utilised. The flank shape optimises the contact surface and surface pressure. This means that a significantly higher level of torque can be transferred compared to conventional gearing geometries whilst retaining the same centre distance. Furthermore, the profile also achieves a greater tooth root thickness which results in the gear sets being insensitive to gear cutting loads, especially at lower speeds.



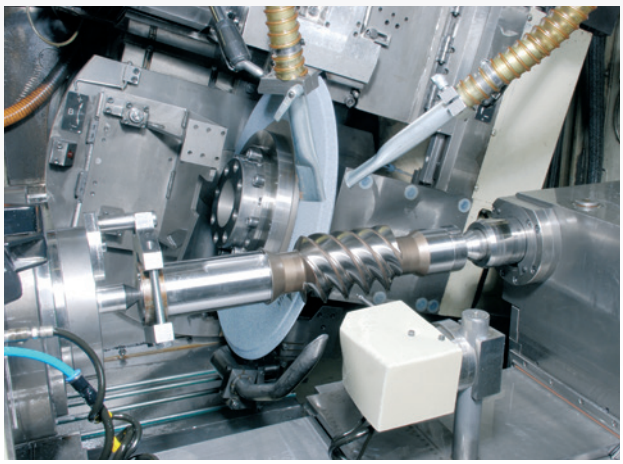
CAVEX® | Conventional worm drive

Profile types	*ZC, ZK, CAVEX®, Duplex*
Centre distance	*40 - 1400mm*
Ratios	*1 - 180*
Module	*1 - 40*
Number of gears	*1 - 12*
Options	*Increased accuracy* *Restricted flank backlash* *Finished dimensions in accordance with customer provisions* *Special designs*

Worm gear set



Worm gear milling



Worm gear grinding

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Cams

Asymmetric ratios

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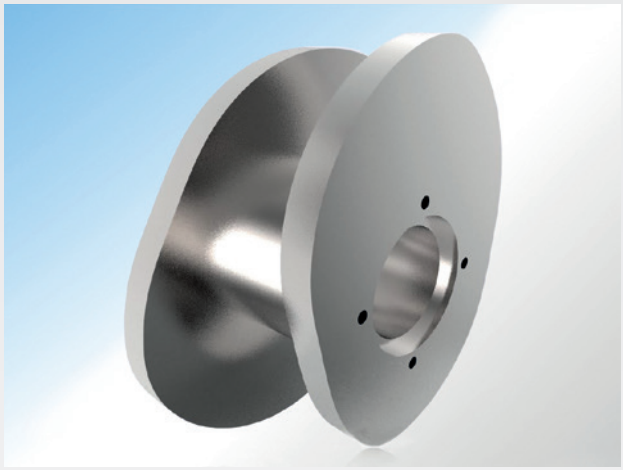
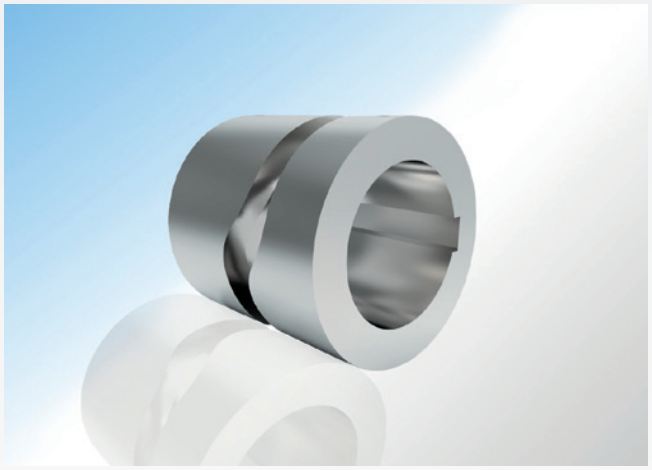
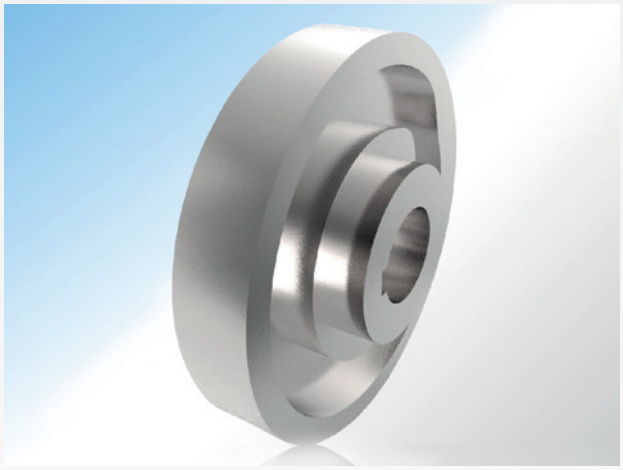
As a basic element of indexing gearboxes, cams enable the implementation of a symmetrical movement in an asymmetric / intermittent movement. Indexing gearboxes are preferred, especially when dealing with high step speeds or large masses to be accelerated. Compared to servomotor solutions, indexing gearboxes are insensitive to external impacts and are also low-maintenance. Depending on the requirements, we also produce radial, groove and cylinder cams in precision designs.



Complementary disc cam



Cylinder cam



Groove cam

	Radial cam	Groove cam	Cylinder cam
Diameter	<2800mm	<2800mm	<400mm
Length	<1000mm	<1000mm	<1600mm
Material	Case-hardening, nitriding and tempering steels, chromium steel		
Heat treatment	Case-hardening, nitriding, inductive-hardening, annealing, penetration hardening		
Options	Spline shaft and hub profiles according to DIN ISO 14, spline shaft profiles according to DIN 5480 and similar, polygons, spur gears, Hirth gearings, separate design		

Sample part production

Reverse Engineering

Thanks to our extensive options in the field of gear wheel reproduction from sample parts, we also offer complete reproduced gearboxes as a replacement:

- *Spur gears*
- *Bevel gears*
- *Herringbone gears*
- *Ground rings*

Before - after (bevel gear re-engineering)

Measurements can be performed using our 3D measuring machines and the existing technical measuring software for gear wheels or, alternatively, by scanning and measuring the parts on site.

A faulty gear wheel can be reconstructed by comparing the scanned or measured values with the theoretically calculated gearing geometries. Bevel gears must be replaced in pairs but all other gearing types can be replaced individually.

Press drive herringbone gear

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Angle & parallel shaft gearboxes

We construct your solutions

WELTER zahnrad

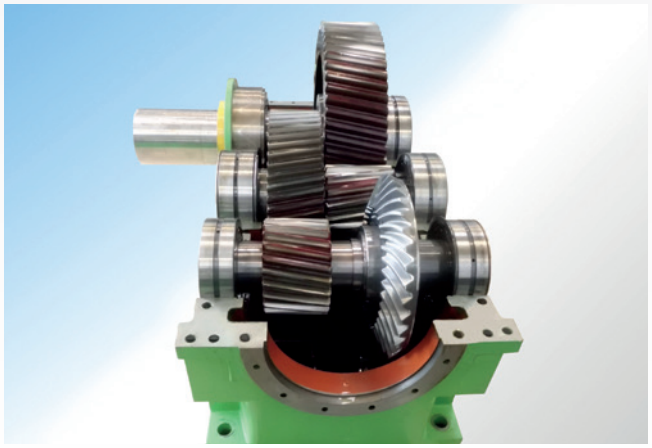
Thanks to our wide range of gearings in the field of spur gears, plane gears and bevel gears combined with our experience in the field of construction and gearing calculation, we offer complete gearboxes for various applications:

- *Wind power (pitch setting)*
- *Railway engineering*
- *Agricultural machinery*
- *Environmental engineering*
- *Escalators and lifts*
- *Conveying engineering*
- *Water power*
- *Tool machines*

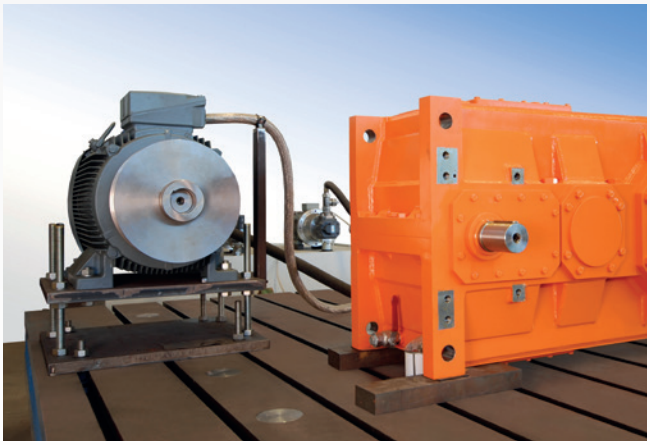
We are more than happy to construct application-oriented solutions in cooperation with our customers. The construction is performed in the 3D Solidworks System. We offer gearbox solutions weighing between 20 and 5000 kg. In doing so, we can also perform the trial operation and strength verifications on in-house test benches.

Single-stage helical gearbox

Pitch setting gearbox



Bevel-helical gearbox



125 kW test bench with closed-circuit oil cooling

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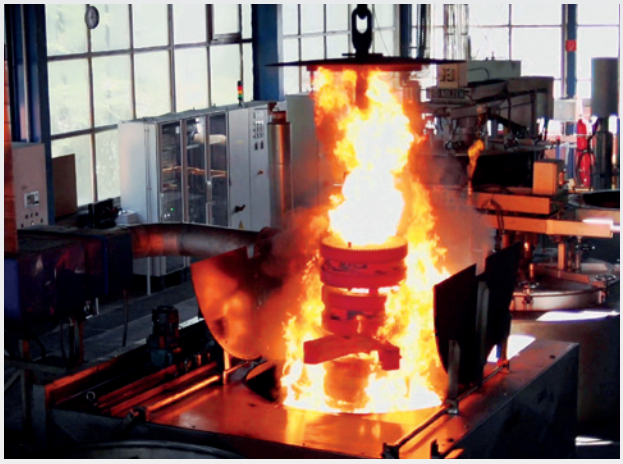
Heat treatment

Important for the service life

In the heat treatment segment, we work with carefully selected partners who meet our strict requirements thanks to continuous process control. Various-sized plants not only cover our complete product range, they also permit the pending hardening processes to be performed at short notice. The heat treatment process is strictly regulated in terms of time and the relevant parameters are monitored with computer assistance. The significant test methods are also offered and performed in the testing laboratory. For documentation purposes, a test piece is included with each furnace batch that is used to demonstrate the hardness profile and is retained for 15 years. All parts are sand-blasted after hardening.

Possible heat treatment methods include:

- *Tempering*
- *Annealing*
- *Case-hardening*
- *Nitriding*
- *Nitro-carburising*
- *Vacuum-hardening*
- *Burnishing*
- *Low-distortion press hardening*
- *Inductive hardening*
- *Straightening up to 100 t*



Quenching in the oil bath

Batching of large parts

Chamber furnace up to d=1250mm

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Engineering

Modern software, experience and knowledge

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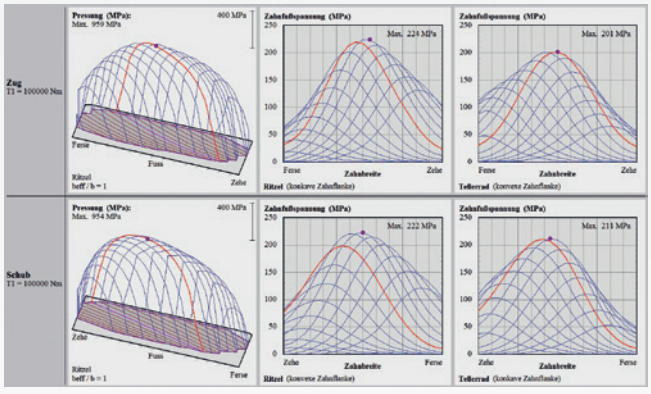
WELTER zahnrad utilises powerful hardware and software, especially in the field of gearbox design. We use the latest version of SOLIDWORKS, the 3D CAD software, when constructing gearboxes and parts.

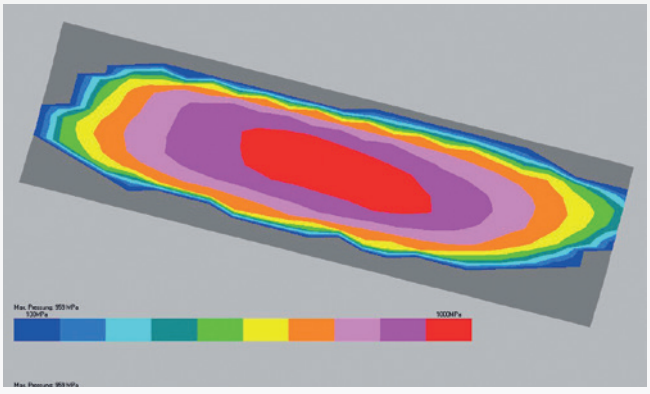
In addition to the verification of load capacity, the flank geometry is extremely important in terms of the noise and temperature behaviour of challenging applications. Our experts have the powerful marketable software packages KISSOFT® and KIMOS® at their disposal. As a member of „FVA“ (German Research Association for Power Transmission Engineering), we also have access to the innovative calculation and simulation software that is only made available to co-designing members. In the field of technical cam, we have Optimus Motus® at our disposal in order to design and calculate the cam track data in order to manufacture using our mdern 5-axis milling machines.

As a result, we are able to create solutions to your complex gear wheel and cam engineering problems and work together with your technical experts in order to implement them in innovative product developments in cooperation with you.

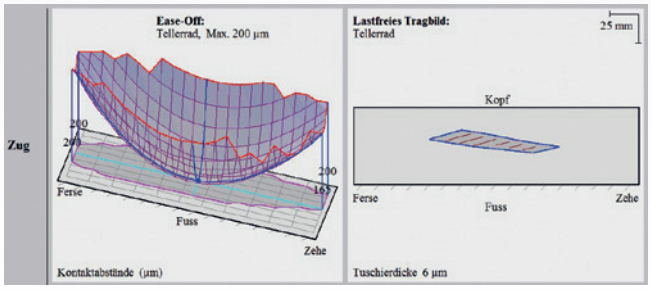
We are happy to assist you with the calculation and design of all gearing types manufactured by our company.



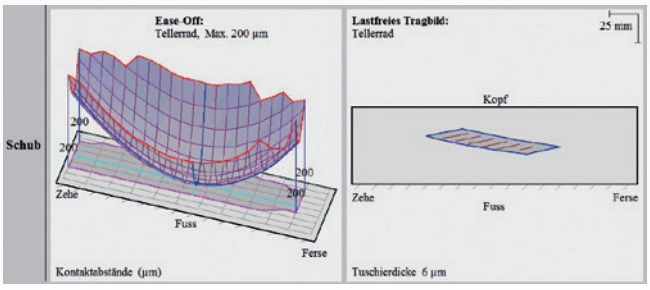
Strength / load analysis



Mathematical distribution of surface pressure



Load-free contact analysis, pull



Load-free contact analysis, push

Quality assurance

The decisive difference

The international reputation and the competitiveness of our company is based on the consistent pursuit of technical innovation and meeting the required quality requirements. In doing so, we build on the experience, technical knowledge and the reliability of our employees in all segments. Furthermore, our quality management system ensures that the quality requirements are met. Our QM-System has been certified according to DIN EN ISO 9001 since 1999. Our QM system is constantly monitored and currently complies with DIN EN ISO 9001:2008.

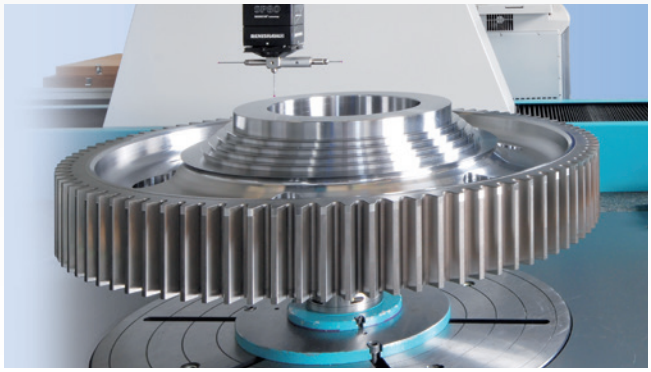
Our quality management system is also certified in accordance with DIN EN ISO 9100:2009 in the aviation industry segment.

Depending on the parameters, the grinding of gear wheels in particular can lead to local overheating and, consequently, to tempering processes which, in turn, result in the premature failure of the spur gear. Therefore, we can examine parts measuring up to D=1000 mm and L=1800 mm according to ISO14104 (AQMA 2007) in-house in Nital-etching baths. Larger parts can be examined according to the „Barkhausen noise“ process.

Single flank milling test

Worm gear test

Nital etching according to ISO 14104 / AQMA 2007



3D measurement of gear wheels

On a project-basis, we have supplied gear wheels that have been documented and accepted by famous classification societies such as:

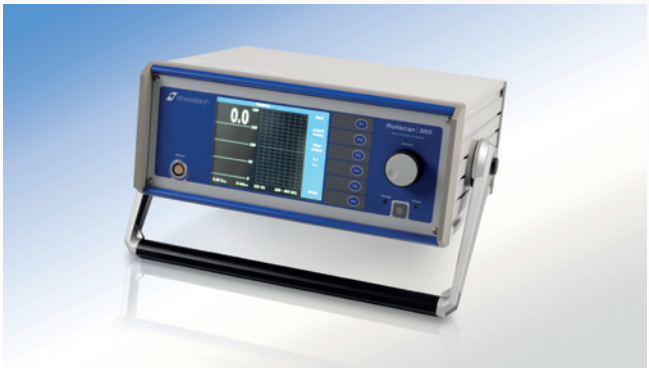
- *GL (Germanischer Lloyd), DNV (Dansk)*
- *DNV (Det Norske Veritas)*
- *ABS (American Bureau of Shipping)*
- *RINA (Registro Italiano Navale)*
- *BV (Bureau Veritas)*
- *Deutsche Bahn quality control*

The results of the quality-assurance tests are documented in measuring records and certificates:

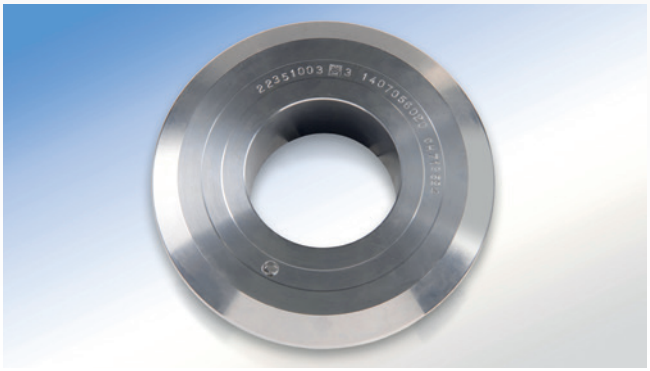
- *Material certificate according to DIN EN 10204 including ultrasonic test where necessary*
- *Tooth contact pattern photograph*
- *Gearing measurement diagram*
- *Single flank test record*
- *Dimensional record*
- *Surface hardness and hardness profile diagram*
- *Initial sample inspection*

In order to ensure and examine the technical quality requirements, we have an extensive range of continuously maintained and calibrated measuring equipment including:

Process	Test characteristic
WENZEL 3D measuring machine	Geometry measurement to d=1800 mm, weight 3000 kg, gearing geometry measurement, bevel gear, spur gear, plane gear, Hirth
Zeiss 3D measuring machine	Geometry measurement to d=900 mm, weight 3000 kg, gearing geometry measurement, bevel gear, spur gear, plane gear, Hirth
Gleason gearing test machine	Gearing record for spur gear and bevel gear
Single flank milling test	Bevel gear and plane gear measurement, including <>90° axial offset and hypoid, incl. wear pattern photograph
Magnetic powder crack test	Crack test according to DIN ISO 9934 / EN 10228
Nital etching bath	Grinding burn testing according to ISO 14104 (AQMA 2007)
Barkhausen noise	Grinding burning can be tested on individual parts / extremely large parts using a measuring device



„Barkhausen noise“ measuring device

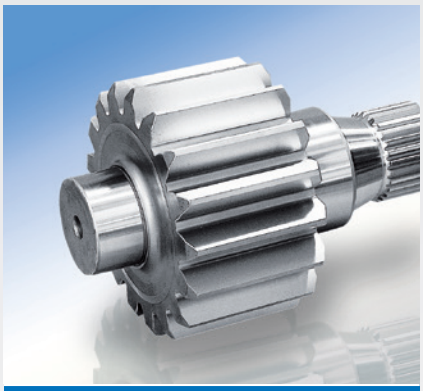


Labelling of the parts after turning

Products and services

WELTER zahnrad at a glance

Bevel gear sets

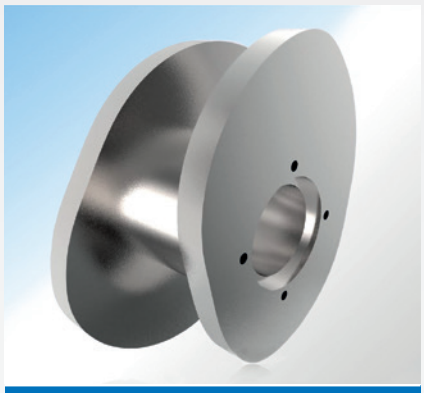


Spur gears/Helical gears

Hirth/face geared couplings

Face gears

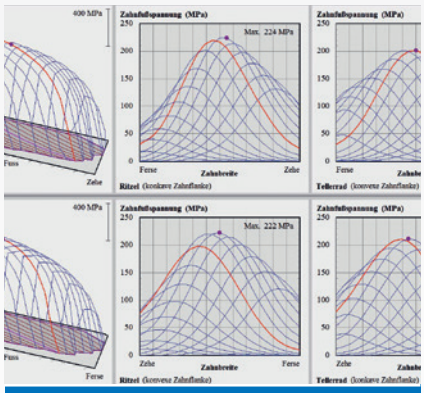
Worm gears



Cams

Sample part production

Gearboxes



Engineering

WELTER zahnrad company brochure, issue 08/2017

The dimensions and illustrations are non-binding. All details are provided subject to specific testing.
All previous versions are no longer valid. The respectively valid version is available at www.welter-zahnrad.com

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