

ZOLLERN

Solid metals. Fine solutions.

Drive Technology
Hydrostatic /
Aerostatic
bearing
systems



The ZOLLERN Group

ZOLLERN is one of the pioneers in the metal industry. At several locations in Europe, North America and Asia, 2,000 employees develop, produce and service a wide range of high-quality metal products. ZOLLERN supplies sophisticated solutions for a wide range of applications with its business areas of drive technology, investment casting, sand casting and forging as well as steel profiles.

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Hydrostatic bearing systems

Wear-free with a high level of running smoothness



Hydrostatic bearing systems; wear-free with calculative unlimited service life



ZOLLERN bearing clearance compensator; intelligent controller system

Hydrostatic bearing systems are characterised by many advantages in application. Their bearing surfaces are always separated from each other by a thin film of lubrication, which prevents solid-state friction. This is achieved through an external pressure supply, which continuously pumps liquid lubricant through inlet channels into the chambers between the bearing surfaces.

Advantages of hydrostatic bearing systems

Wear-free

- Calculative unlimited service life

High level of running smoothness

- No vibrations from any rolling elements

Thermal stability

- Desipation directly by the hydrostatic oil

Friction-free at low speeds

- Maximum positioning accuracy
- No stick-slip effect

High radial and axial run-out accuracy

- < 0.1 µm

ZOLLERN bearing clearance compensator, variable and unique

ZOLLERN has developed a very special variable restrictor system with the bearing clearance compensator. The precise system is integrated directly in the hydrostatic bearing and requires no additional control, capillary or membrane restrictors. The optimal pocket pressure is always set, regardless of the production tolerances. In the restrictor system, a bearing pocket communicates with the 180-degrees opposite bearing pocket by internal oil channels. If load is applied to the shaft, this creates an eccentric displacement. On the one side this creates a reduction. On the opposite side, there is an increase of the restrictor gap. The pressure in the bearing pockets drops or rises disproportionately here and a pressure difference is created between the opposite pockets. The result is a counter-force of the amount of stress and a re-centring of the shaft in the bearing.

The control response time of the bearing clearance compensator are very short and are limited downwards only by the propagation speed of the lubricant pressure.



Hydrostatic bearing systems for turning machines

»» Application in workpiece spindles or rotary tables in the field of hard turning ««

Particular advantage

- Very good damping properties
- Very good radial and axial run-out accuracy
- High achievable surface quality
- Thermally stable, heat dissipation directly via the lubricant





Hydrostatic bearing systems for milling machines

» Application in milling spindles or rotary tables in the field of hard milling «

Particular advantage

- High bearing capacity
- Very good damping properties
- High achievable surface quality





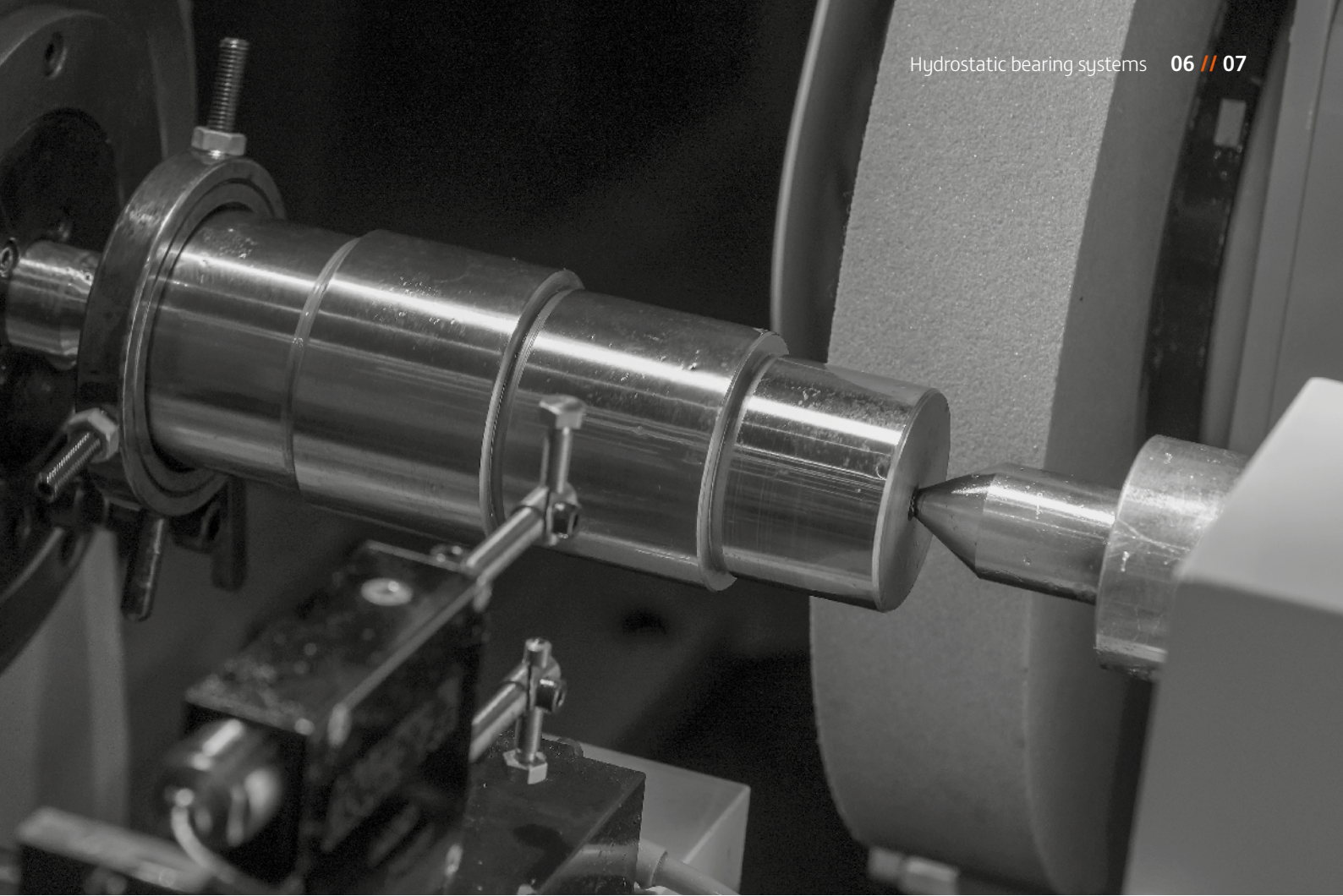
Hydrostatic bearing systems for fine boring machines

»» Application in spindles for piston and connecting rod machining in the automotive industry ««

Particular advantage

- Very high radial and axial run-out accuracy
- Exceptionally high damping of vibrations from the machining process
- High achievable surface quality





Hydrostatic bearing systems for grinding machines

» Application in tool or workpiece spindles as well as rotary tables «

Particular advantage

- Very good damping properties
- Very high radial und axial run-out accuracy
- Thermally stable





Hydrostatic bearing systems for ECM machines

» Use as sleeve bearings «

Particular advantage

- Ideal for quickly oscillating movements
- No bearing wear
- High bearing capacity



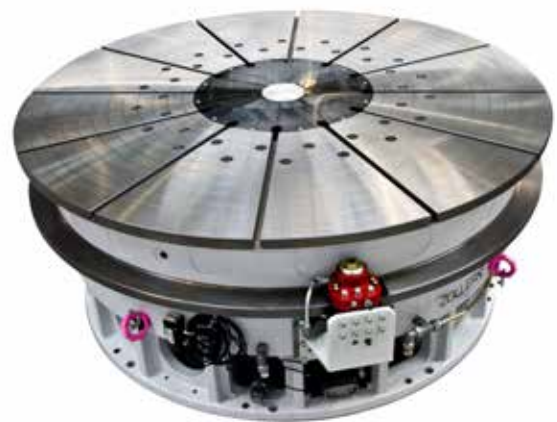


Hydrostatic bearing systems for measuring machines

» Use in rotary tables for coordinate measuring machines «

Particular advantage

- Very high positioning accuracy
- Drive via torque motor or belt drive





Hydrostatic bearing systems for the paper industry

» Use as breast roll bearing
in paper machines «

Particular advantage

- Combined radial and axial movement possible
- Very good damping properties
- Theoretically unlimited service life





Hydrostatic bearing systems for testing and special applications

» Use as bearing in cement mills or in test benches «

Particular advantage

- High bearing load
- Theoretically unlimited service life



Hydrostatic spindles



Bearing diameter: \varnothing 100 mm
Rotation speed: 5,000 rpm
Radial/axial run-out: $< 0.2 \mu\text{m}$
Oil viscosity: ISO VG 5

Application

- Turning machines
- Grinding machines
- Milling machines
- Fine boring machines

Features and properties

- The optimal pocket pressure sets itself regardless of production tolerances
- The ZOLLERN bearing clearance compensator works without susceptible capillaries or controllers
- Delivery with complete hydraulic system and control system optional
- Dimensions according to customer specification
- Composite casting bearing with special emergency running properties

Advantages

- Calculative unlimited service life
- No vibrations from rolling elements
- Thermally stable, heat dissipation directly via the lubricant
- Radial and axial runout accuracy $< 0.1 \mu\text{m}$



Bearing diameter: \varnothing 70 mm
 Rotation speed: 6,000 rpm
 Radial/axial run-out: $< 0.1 \mu\text{m}$
 Oil viscosity: ISO VG 5

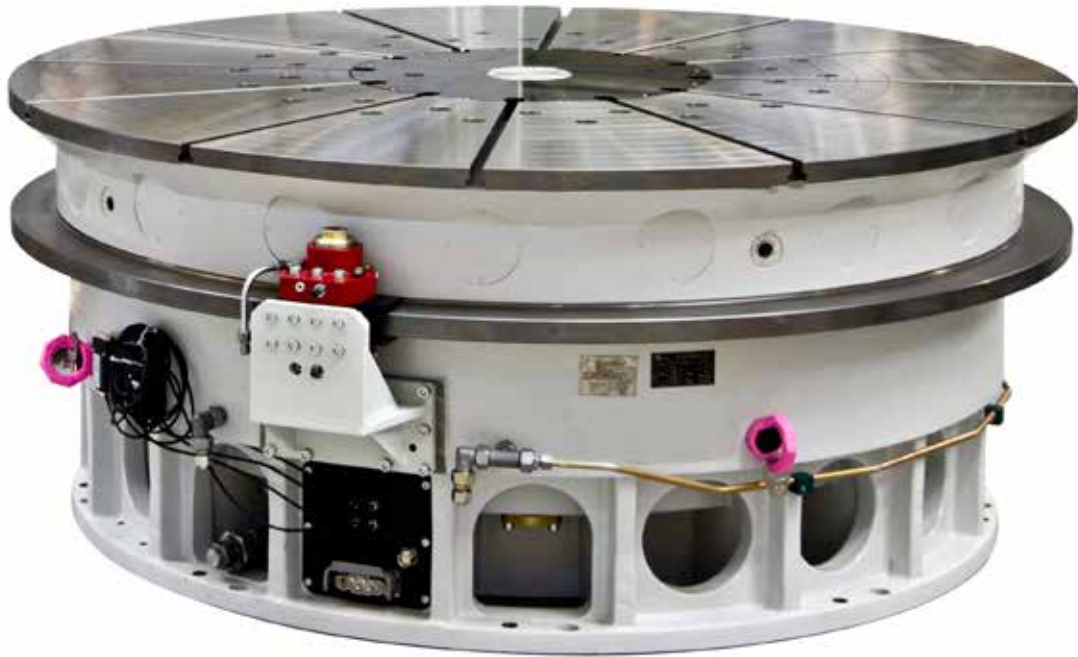


Bearing diameter: \varnothing 90 mm
 Rotation speed: 4,000 rpm
 Radial/axial run-out: $< 0.1 \mu\text{m}$
 Oil viscosity: ISO VG 10

// Installation size

Supply pressure	Radial bearing diameter	External dimensions W x H	Spindle speed	Oil flow rate	Bearing material	Radial/axial run-out
bar	mm	mm	rpm	l/min		μm
60 – 70	30	100 x 110	30,000	8	Steel / White metal	< 0.1
	40	125 x 125	20,000	12		
	50	140 x 140	12,000	15		
	60	180 x 200	7,000	18		
	70	190 x 220	6,000	19		
	80	200 x 250	5,000	20		
	90	210 x 250	4,500	21		
	100	230 x 240	4,000	23		
	110	240 x 240	3,500	25		

Hydrostatic rotary tables



Tabletop diameter: Ø 1,800 mm
Bearing diameter: Ø 1,050 mm
Run-out precision: < 1 µm
Rotation speed: 150 rpm
Axial bearing load capacity: 300 kN

Application

- Turning machines
- Grinding machines
- Milling machines
- Measuring machines

Features and properties

- Combined radial-axial bearing
- The optimal pocket pressure sets itself regardless of production tolerances
- The ZOLLERN bearing clearance compensator works without susceptible capillaries or controllers
- Delivery with complete hydraulic system and control system optional
- Composite casting bearing with special emergency running properties

Advantages

- Calculative unlimited service life
- No ball reversal jump due to rolling element deflections when the direction of rotation is reversed
- Friction-free at low speeds, therefore maximum positioning accuracy; no stick-slip effect
- Radial and axial runout accuracy < 0.5 µm

Tabletop diameter: Ø 1,000 mm
 Bearing diameter: Ø 550 mm
 Run-out precision: < 1 µm
 Rotation speed: 380 rpm
 Axial bearing load capacity: 50 kN



Tabletop diameter: Ø 750 mm
 Bearing diameter: Ø 374 mm
 Run-out precision: < 0.3 µm
 Rotation speed: 10 rpm
 Axial bearing load capacity: 30 kN

// Installation size

Table diameter	Radial bearing diameter	Table rpm	Material	Supply pressure	Oil flow rate	Radial and axial run-out accuracy	Axial load	Radial load
D_T mm	D_B mm	n rpm		P_p bar	Q l/min		F_A KN	F_R KN
600	274	400	Steel/ slide coating	30 – 40	9	< 0.5	30	20
750	374	300			10	< 0.5	40	30
900	460	250			12	< 1	60	35
1,100	550	200			18	< 1	100	40
1,400	770	150			20	< 1	150	50
1,600	825	150			25	< 1	180	50
2,000	1,055	120			40	< 1	250	60
2,500	1,300	100			60	< 1	400	60
2,750	1,415	60			40	< 1.5	800	80
3,000	1,715	40			40	< 1.5	800	80

Hydrostatic guides



Table dimensions: 376 x 405 mm

Stroke: 520 mm

Run-out precision: +/- 3 μ m

Load capacity: 2,000 N

Application

- Turning machines
- Grinding machines
- Milling machines
- ECM machines
- Test benches

Features and properties

- Ideal for quick oscillating movements
- Friction-free at low speeds
- excellent damping properties due to the oil gap
- No vibrations from rolling elements
- Speeds up to 30 m/s

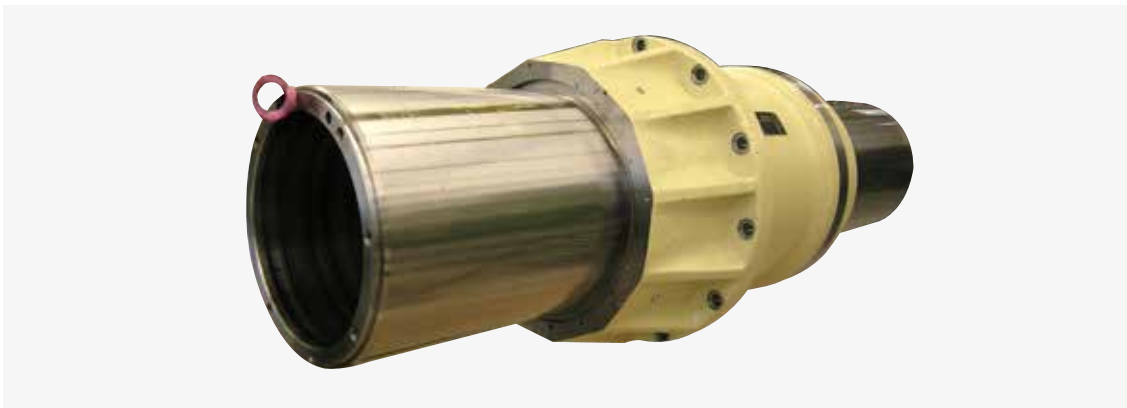
Advantages

- Calculative unlimited service life
- Maximum positioning accuracy
- Thermally stable, heat dissipation directly via the lubricant
- No ball reversal jump due to rolling elements

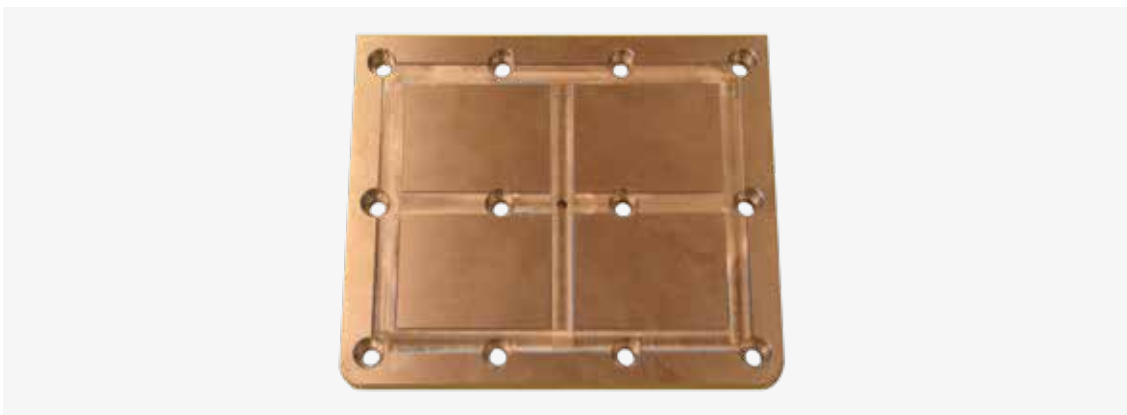


Hydrostatic guides

For integration into the machine base, 73 x 45 x 370 mm



Hydrostatic sleeve guide diameter 400 mm



Hydrostatic guide plates for large machines

Screwed-on guide plates with integrated restrictor system. Dimensions: from 70 x 30 x 7 mm to 440 x 245 x 22 mm

Hydrostatic bearing components

Combined rotary table bearings



Features and properties

- Combined radial-axial bearing
- The optimal pocket pressure sets itself regardless of production tolerances
- The ZOLLERN bearing clearance compensator works without susceptible capillaries or controllers
- Delivery with complete hydraulic system and control system optional
- Composite casting bearing with special emergency running properties

Advantages

- Calculative unlimited service life
- No ball reversal jump due to rolling element deflections when the direction of rotation is reversed
- Friction-free at low speeds; no stick-slip effect
- Radial and axial runout accuracy < 1 μm



Set of bearings for rotary table Ø 4.000 mm



Ready-to-install
bearing pad
Al/Sn coated

Application

- Turning machines
- Grinding machines
- Milling machines

Features and properties

- Hydrostatic axial bearing plates for direct assembly onto the machine base
- Only one hydraulic pump required
- Large cross-sections prevent clogging
- Delivery with complete hydraulic system and control system optional
- Composite casting bearing plates with special emergency running properties

Advantages

- Calculative unlimited service life
- No vibrations from rolling elements
- Excellent damping properties; higher surface quality and longer tool service lives
- Thermally stable, heat dissipation directly via the lubricating oil
- High radial and axial run-out accuracy



Hydrostatic units



Technical design and performance

- Design and delivery of the entire oil supply system with recooling system
- Delivery of monitoring components for pocket pressure or volume flow monitoring of the hydrostatic bearing
- Commissioning of the entire system on site optional
- Use of low-pulsation and low-noise internal gear pumps

Testing / acceptance Measurement equipment

»» Quality measurements at ZOLLERN not only mean measuring in accordance with standards, but also working out and interpreting problem areas.

The measurements are done at ZOLLERN or at the customer's location. «

Laser measurements

Measurements of linear movements is possible in all available degrees of freedom

Measurement lengths:

Up to 80 at position
Up to 15 m for flatness, straightness and angle,
maximum deviation ± 1.5 mm

Accuracies in ideal conditions:

Position: ± 0.5 $\mu\text{m}/\text{m}$
Flatness, straightness and angle: ± 0.1 measurement length $\mu\text{m}/\text{m}$

Measurement of rotary axes in all accuracy requirements and application sizes.

Measurement lengths:

Table diameter from 150 mm to 30,000 mm

Accuracies in ideal conditions:

± 1 Wsec (laser)
 ± 0.2 Wsec (autocollimator)

Niveltronic

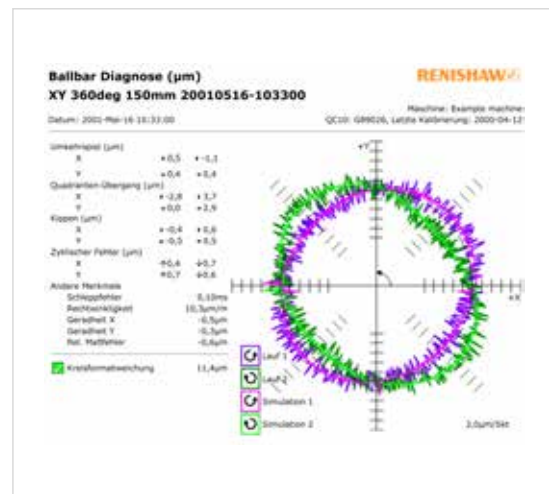
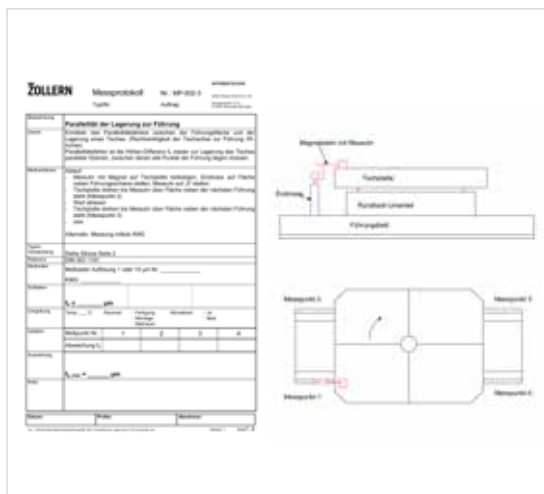
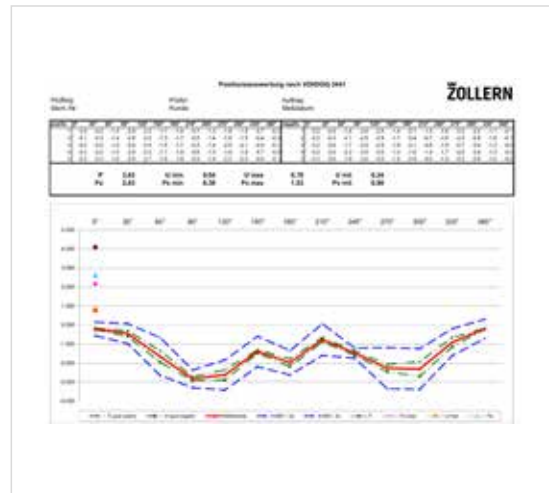
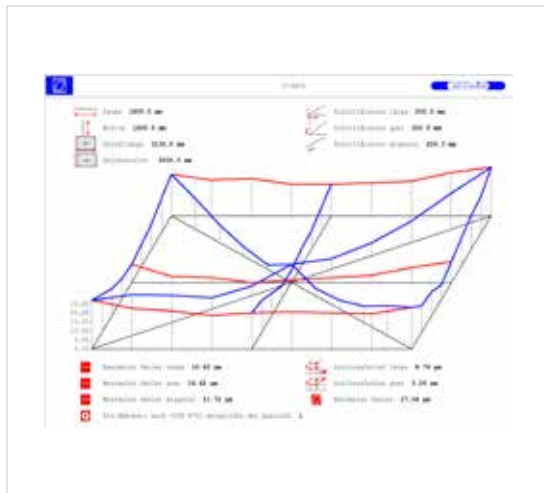
Representation of a flatness measurement method, which can be used in different variations.

- Used when installing systems
- Aligning machine elements to normal water or to existing surfaces

Measurement of a ring surface flatness for using all bearing possibilities.

Resolution of 1 $\mu\text{m}/\text{m}$

Documentation of measurement results



- Extensive documentation of all measurement results
- Graphic representation for better understanding
- Sometimes with description of the measurement procedure
- If desired, summarised to the essentials
- Interpretation of significant deviations from expected values
- Evaluation according to different international standards, such as DIN 230, VDI/DGQ 3441

Comparison of different types of spindle bearings

Spindle bearing	Hydrodynamic	Hydrostatic	Roller bearing
Accuracy	< 0.5 μm	< 0.1 μm	< 1 μm
Size	Similar	Similar	Similar
Load capacity	High Only at average and high speeds	High Full bearing capacity and rigidity, even at a standstill	The highest depends on the speed and the type of bearing
Application	Processing spindle for average and high speeds	Tool spindle Workpiece spindle	Tool spindle Workpiece spindle
Rigidity	Medium	High	Depending on bearing preload
Vibration	No vibration no rolling element	No vibration no rolling element	Vibration through rolling element
Damping	high damping from vibrations caused by machining	high damping from vibrations caused by machining	None Vibration damping
Wear	Limited service life Mechanical wear from mixed friction when starting up and shutting down the system	No wear	Limited service life from mechanical wear
Friction	Depends on speed low speed = low friction high speed = average friction	Depends on speed low speed = low friction high speed = average friction	Average friction
Thermal stability	Depends on speed direct heat dissipation through the oil	Depends on speed direct heat dissipation through the oil	Depends on speed no direct heat dissipation through the oil

Enquiry sheet

Hydrostatic spindles

Company

Contact person

Project

Department

E-mail

Phone

// Type of drive

Built-in motor

Belt drive

Other

// Installation position

Horizontal

Vertical

Other

// Application

Grinding Tool spindle

Turning Workpiece spindle

Milling Test spindle

// Operational data

Rotation speed (rpm)	Bearing rigidity (N/ μ m)		Spindle diameter (mm)	Spindle passage (mm)
	radial	axial		

// Loads

Radial force of the spindle nose (N)	Radial force, drive-side (N)	Axial force (N)

// Run-out accuracy

Radial run-out (μ m)	Axial run-out (μ m)

// Hydraulics

Oil viscosity class	Oil inlet temperature (°C)		Pump pressure (bar)	Operating temperature (°C)
	min	max		

Enquiry sheet

Hydrostatic rotary tables

Company

Contact person

Project

Department

E-mail

Phone

// Table diameter

(mm)

// Rotatoin speed

(rpm)

// Max. workpiece dimensions

Diameter (mm)

Height (mm)

// Run-out accuracy

Radial run-out (μm)

Axial run-out (μm)

// Oil viscosity class (ISO VG)

// Bearing loads

Radial (N)

Axial (N)

// Ambient temperature

min. ($^{\circ}\text{C}$)

max. ($^{\circ}\text{C}$)

// Max. machining forces

Radial (N)

Axial (N)

// Application

Vertical grinder

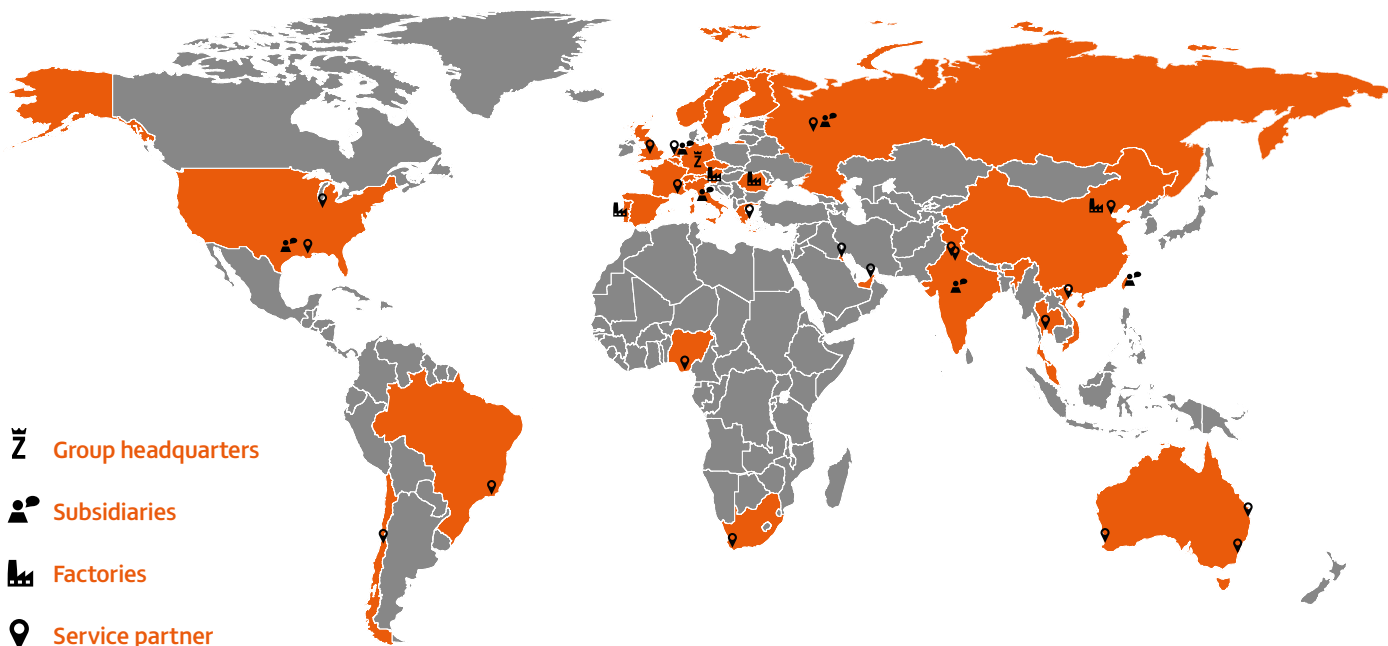
Milling

Other

// Mode of drive

Belt drive

Direct drive



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