

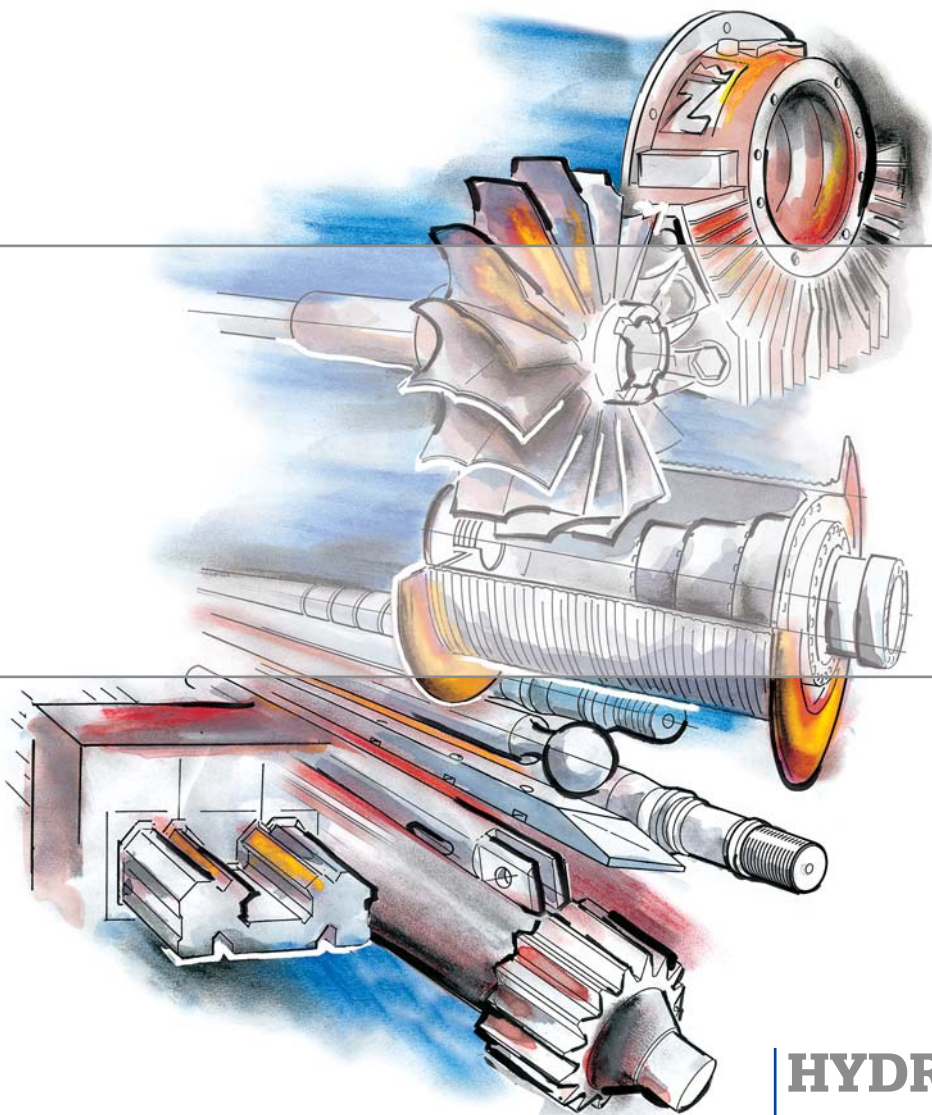
**HYDROSTATIC
BEARING SYSTEMS**



ZOLLERN

PLAIN BEARING TECHNOLOGY





The ZOLLERN Group

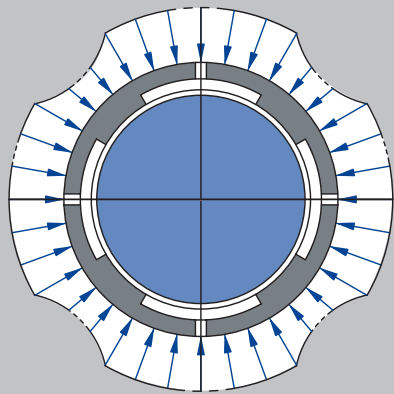
ZOLLERN GmbH & Co. KG is a company with world wide operations, employing over 3000 employees in the business fields of transmission technology (automation, gear boxes and winches), plain bearing technology, machine components, foundry technology and steel profiles.

HYDROSTATIC BEARING SYSTEMS

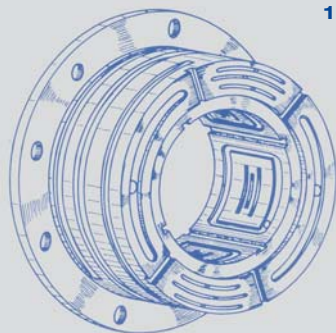
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HYDROSTATIC THROTTLE SYSTEMS

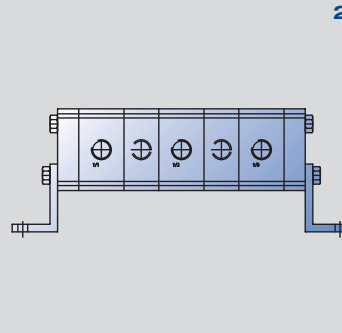
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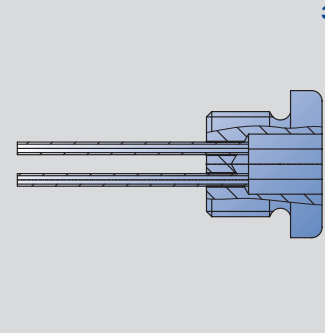
- ZOLLERN bearing clearance compensator
- Precision flow divider
- Capillary throttles/tubes



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1 Bearing clearance compensator – characteristic

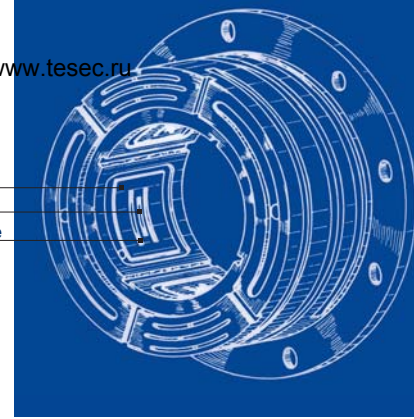
- ZOLLERN standard configuration for an economical serial production
- Ready-to-install bearings
- Compact design
- No adjustment of preliminary throttles after installation
- High running speeds, up to 50 m/s
- Use of low-viscosity oils or fluids
- Constant pocket pressure, independent of running speed with an iso-viscous behaviour of the ZOLLERN clearance compensator
- High operation accuracy
- High stiffness
- Best-efficient damping

2 Precision flow-divider – characteristic

- High bearing loads
- High bearing stiffness
- Low hydrostatic power-loss
- Feasibility of generous bearing clearances
- Bearing systems with and without wrap-around
- External piping required

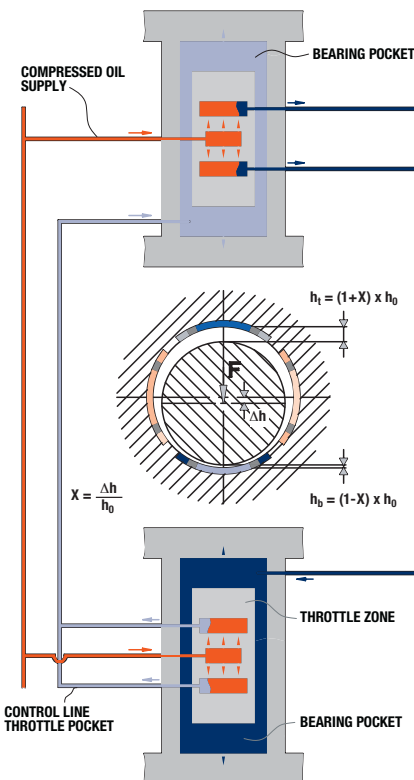
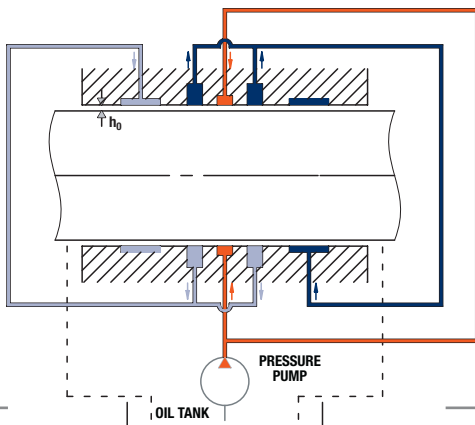
3 Capillary tubes – characteristic

- Low sliding speed
- Bearing systems without wrap-around
- Single hydrostatic pockets
- Adjustment of capillaries required after production



Plateau
P_p pump groove
P_T pocket groove

ZOLLERN BEARING CLEARANCE COMPENSATOR



The long experience by our company in the field of slide bearing metallurgy led us to the development of hydrostatic bearing systems. From the outset, ZOLLERN has used a special form of preliminary throttle system, the so-called 'ZOLLERN bearing clearance compensator'.

Bearing operation

The respective Plateau in the centre of each pocket is machined by the same plane of the bearing. A pump groove P_p which is connected to the pressure pump is milled into the centre of each plateau. The pocket grooves P_T are arranged to the left and the right of the pump grooves. The compressed oil flows sideways to the pocket grooves P_T and supply the opposite arranged bearing pocket with compressed oil, by a bypass channel.

Now if the shaft is loaded by the force F, an off-centre displacement is done which gives in the lower area to a reduction of the throttle gap and in the upper area to an enlargement of the throttle gap. The ratio is the so-called relative gap modification.

This displacement also modifies the outflow gaps from the bearing pockets in the same way, the pressure falls in the upper pocket to an over-proportional extent and rise up in the lower pocket to an over-proportional value.

The pressure difference between the pockets, multiplied by their effective surface area, produces definitely the same counterforce as the force applied.

COMPOUND BEARING MATERIALS

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Compound castings for efficient hydrostatic applications

We optimize our hydrostatic bearing components with special compound materials. By using different combinations, we are able to meet your demands for products, capable fulfilling the most wide-ranging applications. Thereby we produce diffusion bonds between steel and lead-bronze, steel and white metal as well as compounds based on aluminum.

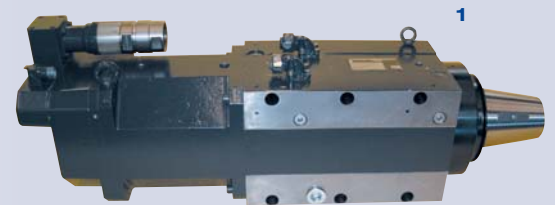
Name of compound	Properties	Application
St/SnSb8Cu4	<ul style="list-style-type: none"> • Best sliding properties and emergency-run characteristics • High sliding speeds • Outstanding embedding • Surface pressure up to 15 N/mm² 	<ul style="list-style-type: none"> • Radial bearings • Thrust bearings
St/AlSn20 St/CuPb22Sn	<ul style="list-style-type: none"> • Good sliding properties and emergency-run characteristics • Good embedding capability • Surface pressure up to 18 N/mm² / 75 N/mm² 	<ul style="list-style-type: none"> • Guide plates
St/CuPb20Sn5 St/CuPb15Sn8	<ul style="list-style-type: none"> • Good sliding properties and emergency-run characteristics • Good embedding capability • High surface pressure up to 75 N/mm² 	<ul style="list-style-type: none"> • Thrust bearings • Radial bearings
St/plastic	<ul style="list-style-type: none"> • Good sliding properties and emergency-run characteristics • Corrosion resistance • Surface pressure up to 8 N/mm² 	<ul style="list-style-type: none"> • Air gap seals • Water bearings

Special bearing materials

CuAl10Ni5Fe4	<ul style="list-style-type: none"> • High strength aluminium-bronze • Good sliding properties and emergency-run characteristics • Tensile strengths up to 750 N/mm² • High corrosion resistance 	<ul style="list-style-type: none"> • Special bearings • Water bearings
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- Grinding spindle units
- Milling spindle units
- Workpiece- and turning spindle units
- Fine drilling spindle units
- Multi-spindle units

HYDROSTATIC SPINDLE UNITS



1 Grinding spindle unit

Bearing diameter: 110 mm
Spindle speed: 1500–6000 rpm
Radial and axial runout: $< 0.5 \mu\text{m}$
Application: high precision grinder

2 Fine drilling spindle unit, 3-way

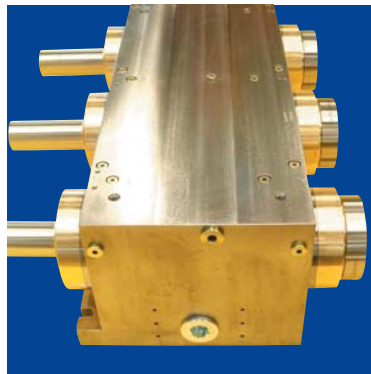
Bearing diameter: 70 mm
Spindle speed: 1000–6000 rpm
Workpiece roundness: $< 0.5\text{--}1 \mu\text{m}$
Application: fine drilling of conrod bearing holes in one production step

3 Multi-spindle unit, 7-way

Bearing diameters: 32–50 mm
Spindle speed: 1800–4000 rpm
Workpiece roundness: $< 0.5\text{--}1 \mu\text{m}$
Application: simultaneous fine drilling of bearing holes

4 Drilling rod guide

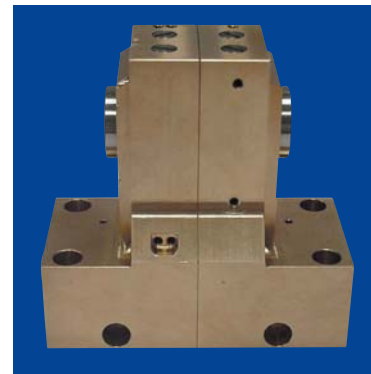
Bearing diameter: 40 mm
Spindle speed: 2500 rpm
Radial runout: $< 0.5 \mu\text{m}$
Application: drilling-rod guidance



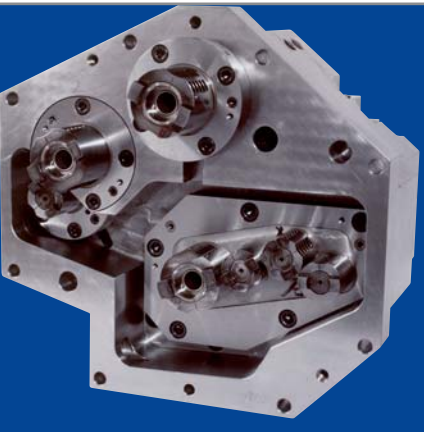
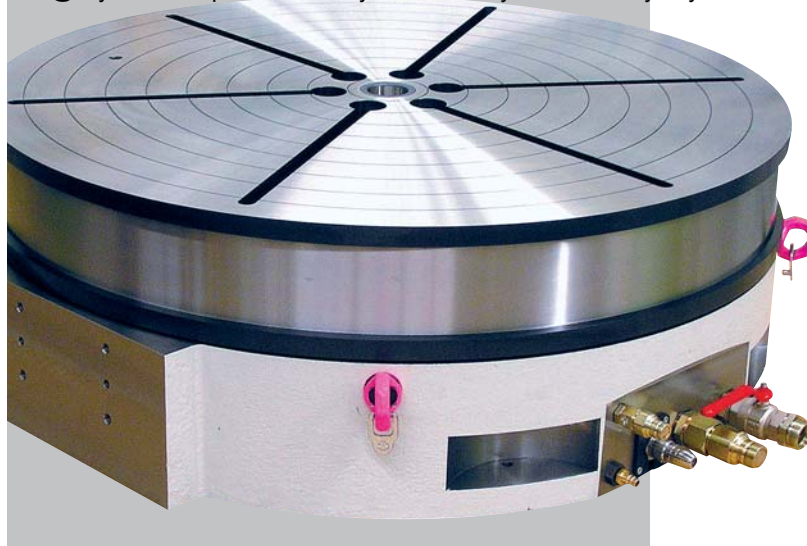
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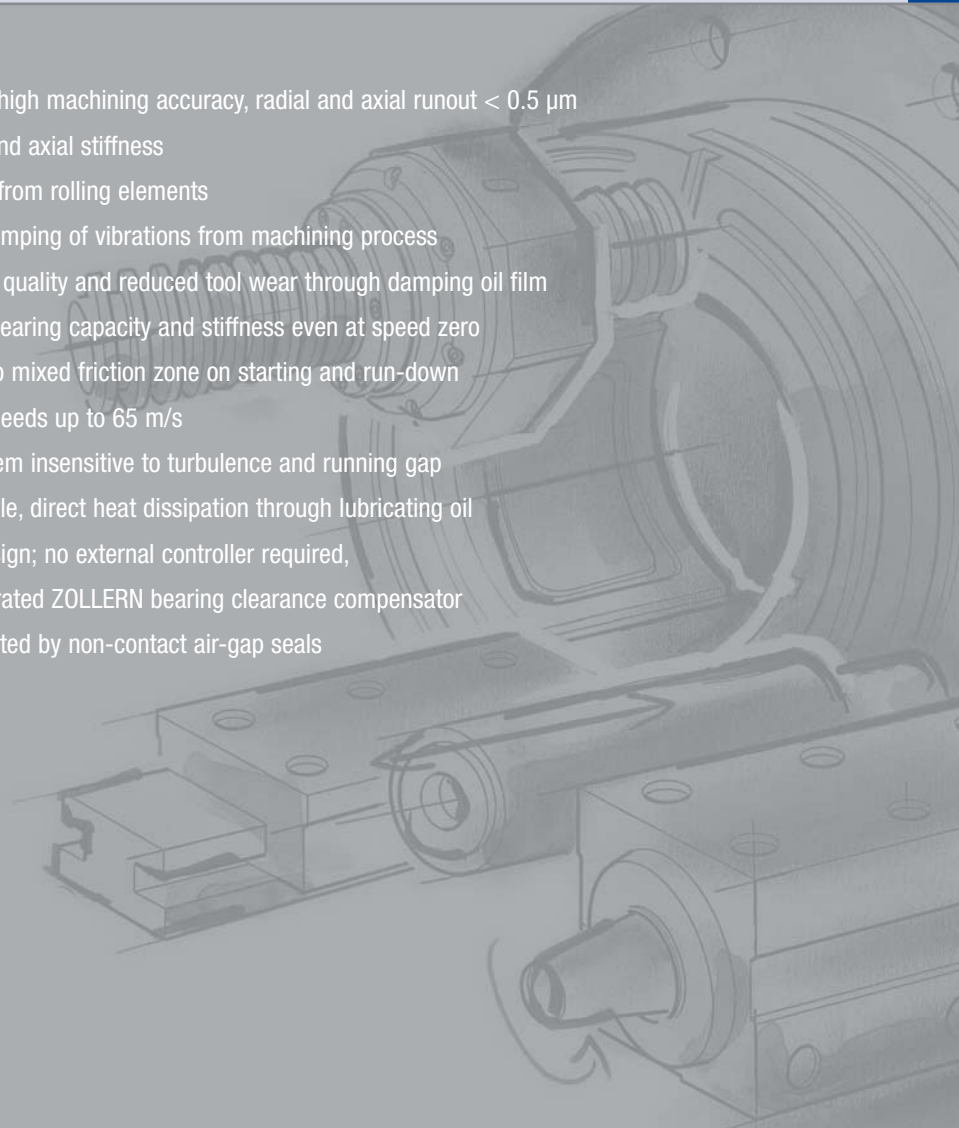
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5 Rotary-table unit

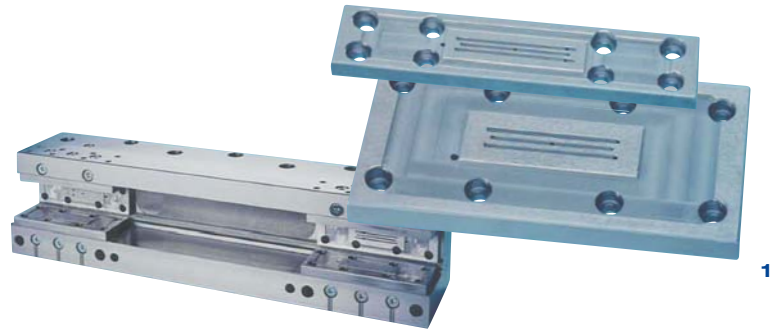
Bearing diameter: 550 mm
Face-chuck diameter: 1000mm
Axial load: 120 KN
Application: measuring machines,
vertical grinders
Radial axial runout: <math>< 1\mu\text{m}</math>

Features

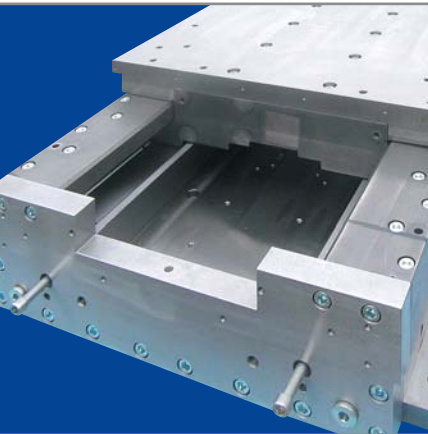
- Outstanding high machining accuracy, radial and axial runout <math>< 0.5\ \mu\text{m}</math>
- High radial and axial stiffness
- No vibration from rolling elements
- Maximum damping of vibrations from machining process
- High surface quality and reduced tool wear through damping oil film
- Full load of bearing capacity and stiffness even at speed zero
- Wear-free, no mixed friction zone on starting and run-down
- Peripheral speeds up to 65 m/s
- Throttle system insensitive to turbulence and running gap
- Thermal stable, direct heat dissipation through lubricating oil
- Compact design; no external controller required, thanks integrated ZOLLERN bearing clearance compensator
- Sealing effected by non-contact air-gap seals



- Guideways with and without wrap-around
- Guideway-units with linear motors
- Round guideways, simultaneous linear- and rotary movements
- V-Flat guides
- Guide rails
- Guide plates



HYDROSTATIC GUIDEWAYS

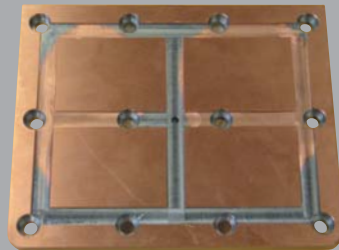


Features

- Unlimited theoretical lifetime
- Outstanding suitable for oscillation movements
- No ball redirection from rolling elements
- No friction by low motion, no stick-slip effect
- Maximum positioning accuracy, no backlash
- High damping by oil-filled lubrication gap
- No vibrations from rolling elements
- Maximum possible damping of vibrations from machining process
- High security against collisions
- Wear-free, no metallic contact
- Speeds up to 50 m/s
- Thermal stable, direct heat dissipation through lubrication oil
- High machining accuracy and repeatability

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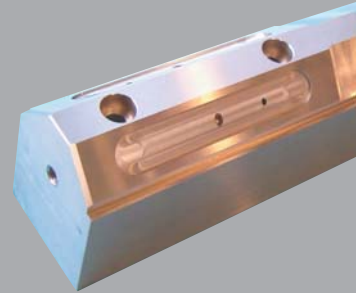
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1 Hydrostatic C-guide rails with screw-mounted guide plates

Speed: 24 m/min.
Operating accuracy: < 1 μm
Application: revolver guidance for lathes/hard machining

2 Hydrostatic guideway unit with integrated linear motor.

Run-off precision: < 1 μm .
Stroke: 350mm
Application: infeed-axis for grinders

3 Hydrostatic guide plates

Screw-mounted guide plates with integrated preliminary throttle
Dimensions: from 70 x 30 x 7 mm up to 440 x 245 x 22 mm.

4 Hydrostatic guide rail

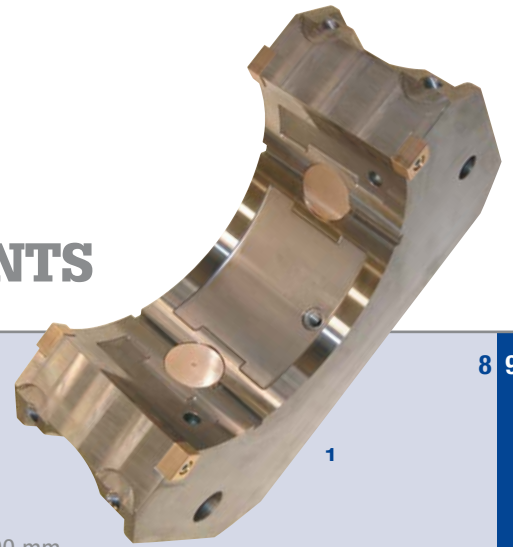
Stroke: 800 mm
Run-off accuracy: < 1 μm
Application: ready-to-install components for slide-guide

5 Hydrostatic V-Flat

Stroke: 200 mm
Oscillation: 300 min^{-1}
Run-off accuracy: < 2 μm
Application: rapidly oscillating slides

- Rotary-table bearings
- Bearing sets
- Bearing segments
- Thin-walled radial bearings
- Supporting bearings

HYDROSTATIC BEARING COMPONENTS



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Features

- Compact design
- Applicable into existing machines
- High positioning accuracy, frictionless by low speed
- Rotary-table bearings from diameter 80 mm up to 2000 mm
- Spindle sleeve bearings from diameter 35 mm up to diameter 500 mm
- Integrated linear and rotary movements in a single bearing



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1 Radial supporting bearings

Bearing diameter: 100 up to 800 mm
Operating accuracy: < 2 μ m
Radial loads: up to 100 kN
Water can be used as pressurized medium

2 Radial bearings

System: bearing clearance compensator
Bearing diameter: 430 mm
Speed: 1600 rpm
Operating load: 13,000 N
Radial runout: < 1 μ m
Application: special lathes

3 Thin-walled radial bearings

Bearing diameters: 60 up to 240 mm
Pre-finished to shrink in the machine housing
High damping by constant oil film, significantly longer tool life
Operating accuracy: < 1 μ m
Application: spindle sleeves for machine tools, shrink-fitted into the machine housing

4 Radial-axial bearings – rotary table bearings

Applicable instead of YRT ball-bearings
Bearing diameters: 250–2000 mm
Operating accuracy: < 2 μ m
Axial loads: up to 500 kN
Radial loads: up to 50 kN
Application: rotary table bearings for machine tools and heavy machining centres

5 Radial bearings – spindle sleeves

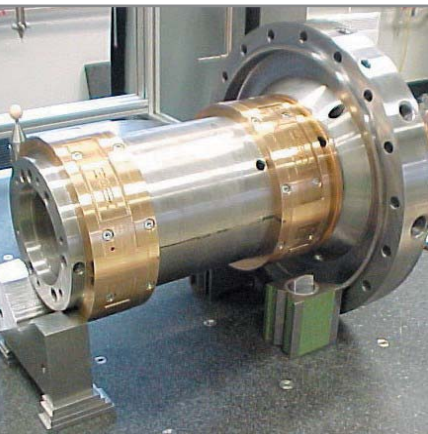
Bearing diameters: 80–500 mm
High damping, significantly longer tool life
Application: spindle sleeves for main-spindle-bearings of vertical lathes

6 Heavy-duty radial-axial bearing

System: pump per pocket
Bearing size: \varnothing 500mm x 350 mm
Operating load: 500 000 N
Spindle speed: 200 rpm
Radial and axial runout: < 5 μ m
Application: heavy duty lathes

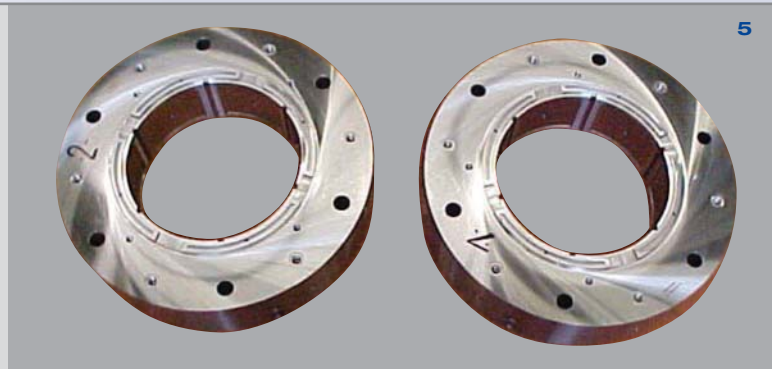


SPECIAL HYDROSTATIC TEST BEARINGS



Features

- High radial and axial stiffness
- No vibrations by rolling elements
- Maximum possible damping of vibrations from testing process
- Feasibility of making precise measurements of friction torques
- Frictionless by low speed
- Maximum load capacity already at speed zero
- Free of wear, no metal to metal contact



1 Radial bearings for test cylinders

Piston rod diameters: 45 up to 440 mm
 Material: steel/bronze
 Operating pressure: 280 bar

2 Friction balance test rig

Measurement of the friction torque of roller bearings under several operating loads

3 Bearing unit, special design

Bearing size: 260 mm
 Speed: 1200 rpm
 Application: tire test rig for measuring the tire-noise

4 Friction balance

Radial load: 250 kN
 Axial load: 100 kN
 Transmission of force via bearing housing
 Application: measurement of friction torque of roller bearings

5 Radial bearings, special configuration

Bearing diameter: 240 mm
 Radial load: 250 kN
 Axial load: 45 kN
 Application: test-system for testing hydrodynamic slide bearings

HYDROSTATIC LEAD SCREWS

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Hydrostatic lead screws permit the wear-free transmission of power from rotary movements to linear movements. Thanks to the no-play and hydrostatic pre-stressed nut, the hydrostatic lead screws are particularly suitable for highly dynamic, precise positioning functions in continuous non-stop operation.

Features

- Unlimited theoretical life-time
- No vibrations from rolling elements
- No ball backlash through rolling element by reversal of rotation direction
- Frictionless by low speeds, in that way maximum positioning accuracy
- No stick-slip effect
- Economical alternative to linear motors
- Free of wear, no metal contact between the elements
- Speeds up to 90 m/min.
- Thermally stable, direct heat dissipation through lubricant
- Excellent suitable for rapid, oscillating movements
- Lead screws with external dimensions to customers' specifications can be supplied

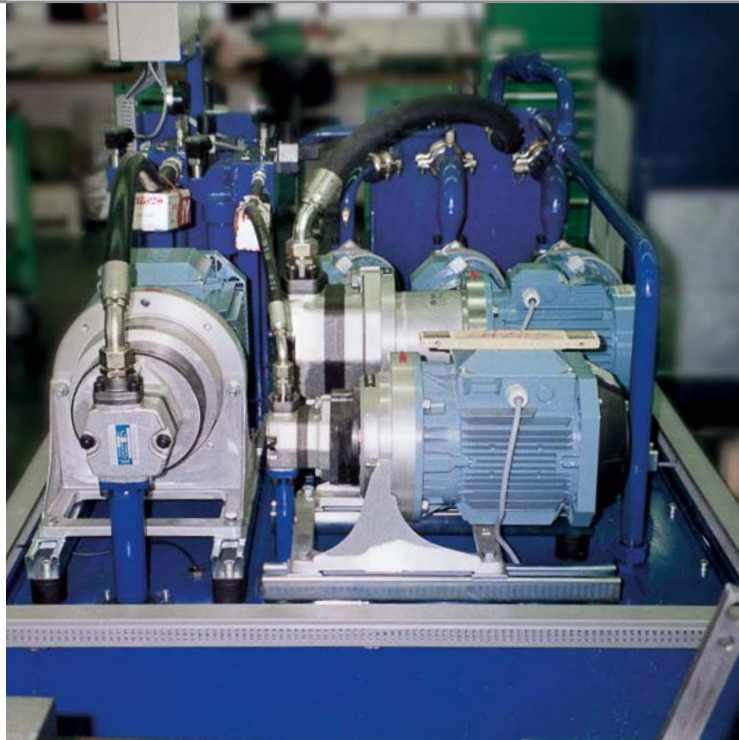
Hydrostatic lead screw
ZHGT 63x14





ADDITIONAL EQUIPMENT

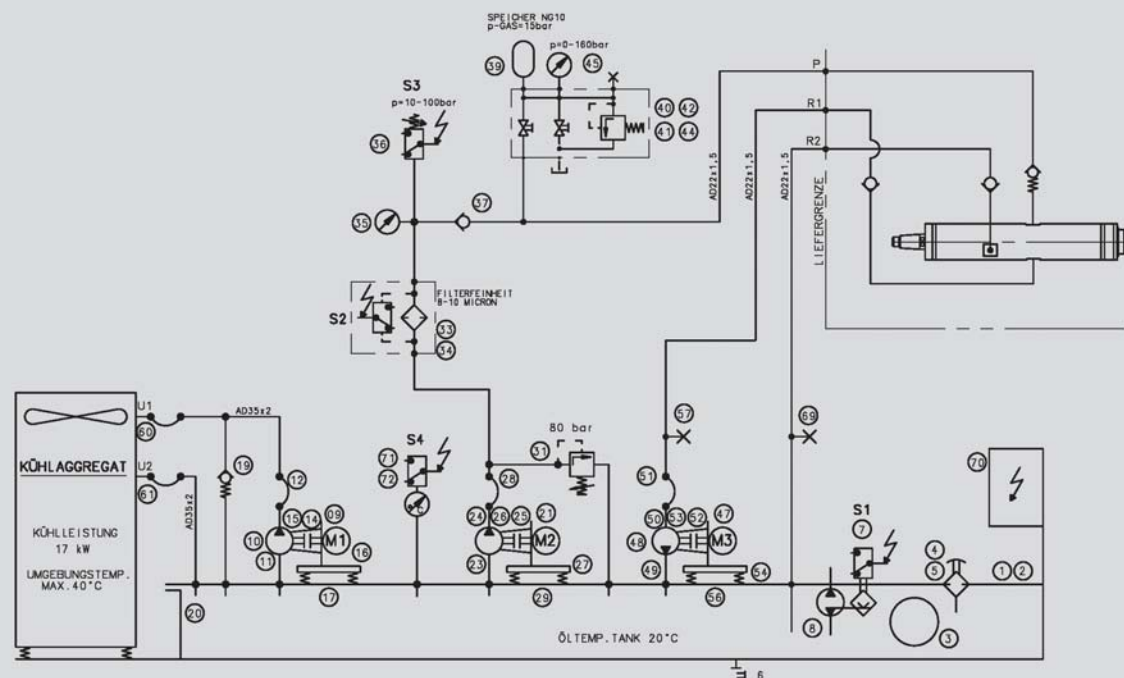
- Oil supply systems
- Oil cooling systems
- Monitoring components
- On-site commissioning service





Engineering services

- Planning and delivery of complete oil supply system, oil cooling system included
- Delivery of components for monitoring pocket-pressure or monitoring volumetric flow rate of the hydrostatic system
- If required by the customer, commissioning of complete systems on-site
- Use of low-pulsation, low-noise internal gear pumps



ENQUIRY FOR HYDROSTATIC GUIDEWAYS

ZOLLERN GmbH & Co. KG

Heustrasse 1, D-88518 Herbertingen

Sales hydrostatic:

Tel. +49 75 86 95 95 38 Mr. Knaus

Fax +49 75 86 95 97 15

eMail michael.knaus@zollern.de

Name _____

Company _____

Address _____

Tel. _____ Fax _____

Email _____ Date _____

Mode of drive

- Linear motor
- Hydrostatic lead screw
- ball screw
- Other _____

Type of guide

- Round guide
- Flat guide with or without wrap-around
- V-flat guide
- Determined by ZOLLERN

Application

- Grinding
- Turning
- Milling
- Other

Kinetic magnitudes

a max _____ m/s²
v max _____ m/min
n osc _____ min⁻¹
stroke _____ mm

Run-off precision

Supporting guide _____ μm
Directional guide _____ μm
 Determined by Zollern

Installation position

- Horizontal
- Vertical
- angular _____ °

Hydraulic

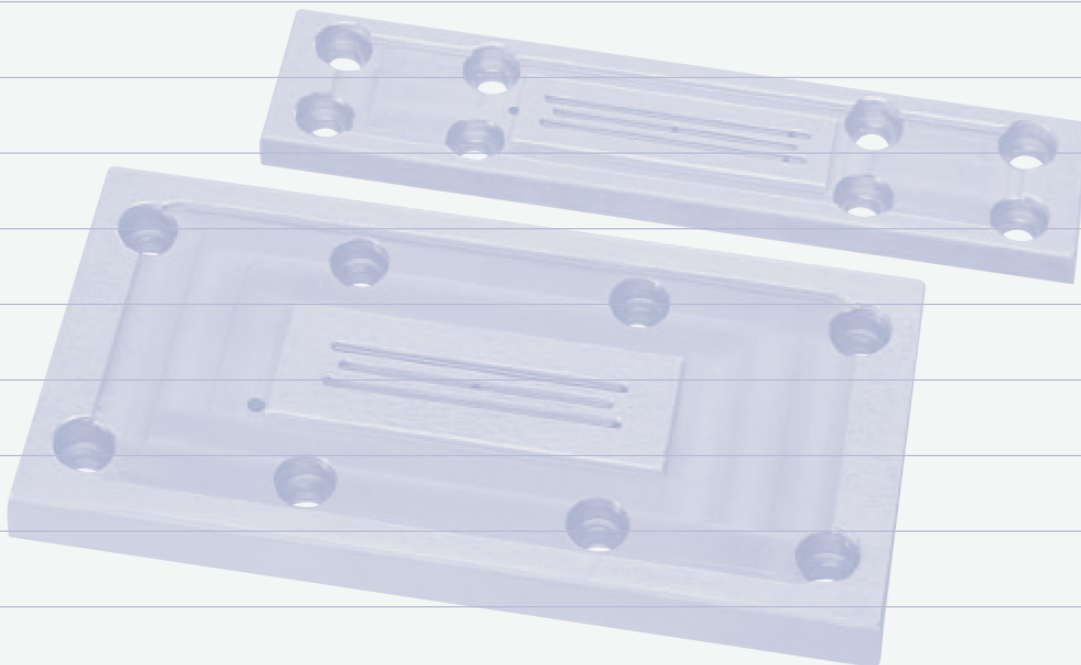
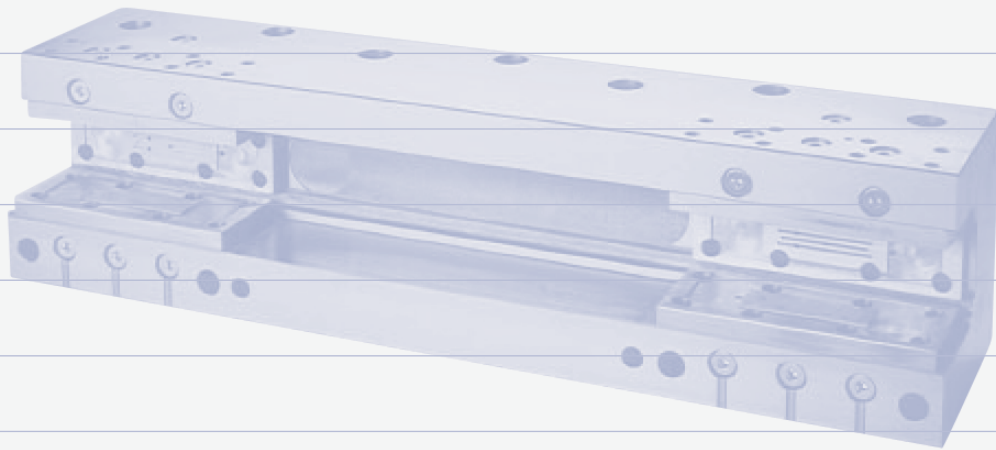
Oil viscosity: VG _____ mm²/s at 40°C Operating temperature _____ °C
Pump pressure _____ bar Ambient temperature _____ °C
Oil inlet temperature min. _____ °C
max. _____ °C Determined by ZOLLERN

Loads

Max. weight of slide _____ N Slide centre of gravity
Max. weight of replaceable build-up construction _____ N Centre of gravity of replaceable build-up construction
Max. machining forces _____ N Point of application of machining forces

Note

To enable us to design your hydrostatic guideway, please enclose a cross-section drawing or sketch of the existing guide or the intended location showing the available space.



ENQUIRY FOR HYDROSTATIC SPINDLES

ZOLLERN GmbH & Co. KG

Heustrasse 1, D-88518 Herbertingen

Sales hydrostatic:

Tel. +49 75 86 95 95 38 Mr. Knaus

Fax +49 75 86 95 97 15

eMail michael.knaus@zollern.de

Name _____

Company _____

Address _____

Tel. _____ Fax _____

Email _____ Date _____

Mode of drive

- Built-in motor
- Belt drive
- Other

Installation position

- Horizontal
- Vertical
- angular _____°

Application

- Grinding spindle
- Tool spindle
- Turning spindle
- Workpiece spindle
- Milling spindle
- Test spindle

Operating data

Spindle speed max.: _____ rpm
Bearing stiffness radial _____ N/ μ m
axial _____ N/ μ m

Spindle diameter _____ mm
Spindle opening _____ mm

Operating accuracy

Radial runout _____ μ m
Axial runout _____ μ m
 Determined by ZOLLERN

Hydraulic

Oil viscosity: VG _____ mm²/s at 40°C
Pump pressure _____ bar
Oil inlet temperature: min. _____ °C
max. _____ °C
Operating temperature: _____ °C
Ambient temperature _____ °C
 Determined by ZOLLERN

Loads

Max. radial loads/spindle nose _____ N Points of application of machining forces
Max. radial loads/drive side _____ N Points of application/radial loads
Max. axial loads _____ N Points of application/axial loads

Note

To enable us to design your hydrostatic spindle, please enclose a cross-section drawing or sketch of existing spindle or the intended location showing the available space.