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

- Hydrostatic throttle systems
- ZOLLERN bearing clearance compensator
- Compound bearing materials
- Hydrostatic spindle units
- Hydrostatic guideways
- Hydrostatic bearing components
- Hydrostatic test bearings
- Hydrostatic lead screws
- Additional equipment
- Enquiry forms
HYDROSTATIC THROTTLE SYSTEMS

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
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 counter-force as the force applied.
## Compound Bearing Materials

### 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.

<table>
<thead>
<tr>
<th>Name of compound</th>
<th>Properties</th>
<th>Application</th>
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</table>
| St/SnSb8Cu4      | - Best sliding properties and emergency-run characteristics  
                  - High sliding speeds  
                  - Outstanding embedding  
                  - Surface pressure up to 15 N/mm² | - Radial bearings  
                                                                 - Thrust bearings |
| St/AlSn20        | - Good sliding properties and emergency-run characteristics  
                  - Good embedding capability | - Guide plates |
| St/CuPb22Sn      | - Good sliding properties and emergency-run characteristics  
                  - Good embedding capability  
                  - Surface pressure up to 18 N/mm² / 75 N/mm² | - Thrust bearings  
                                                                 - Radial bearings |
| St/CuPb20Sn5     | - Good sliding properties and emergency-run characteristics  
                  - Good embedding capability  
                  - High surface pressure up to 75 N/mm²  
                  - Corrosion resistance  
                  - Surface pressure up to 8 N/mm² | - Air gap seals  
                                                                 - Water bearings |
| St/plastic       | - Good sliding properties and emergency-run characteristics  
                  - Corrosion resistance  
                  - Surface pressure up to 8 N/mm² | - Water bearings |

### Special bearing materials

| CuAl10Ni5Fe4    | - High strength aluminium-bronze  
                  - Good sliding properties and emergency-run characteristics  
                  - Tensile strengths up to 750 N/mm²  
                  - High corrosion resistance | - Special bearings  
                                                                 - Water bearings |
HYDROSTATIC BEARING SYSTEMS

- 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 µm
- Application: high precision grinder

2 Fine drilling spindle unit, 3-way
- Bearing diameter: 70 mm
- Spindle speed: 1000–6000 rpm
- Workpiece roundness: < 0.5–1 µm
- 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: < 0.5–1 µm
- Application: simultaneous fine drilling of bearing holes

4 Drilling rod guide
- Bearing diameter: 40 mm
- Spindle speed: 2500 rpm
- Radial runout: < 0.5 µm
- Application: drilling-rod guidance

ZOLLERN HYDROSTATIC BEARING SYSTEMS
5 Rotary-table unit
Bearing diameter: 550 mm
Face-chuck diameter: 1000mm
Axial load: 120 KN
Application: measuring machines, vertical grinders
Radial axial runout: < 1µm

Features
• Outstanding high machining accuracy, radial and axial runout < 0.5 µm
• 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

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: 350 mm
   - 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
HYDROSTATIC BEARING COMPONENTS

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

1 Radial supporting bearings
- Bearing diameter: 100 up to 800 mm
- Operating accuracy: < 2 µm
- 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 µm
- 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 µm
- 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 µm
- Axial loads: up to 50 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: ø500mm x 350 mm
- Operating load: 500,000 N
- Spindle speed: 200 rpm
- Radial and axial runout: < 5 µm
- Application: heavy duty lathes
SPECIAL HYDROSTATIC TEST BEARINGS

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

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
HYDROSTATIC LEAD SCREWS

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
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 7586 95 95 38 Mr. Knaus  
Fax +49 7586 95 97 15  
eMail michael.knaus@zollern.de

---

**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**
- $a_{\text{max}}$: ______ m/s$^2$
- $v_{\text{max}}$: ______ m/min
- $n_{\text{osc}}$: ______ min$^{-1}$
- Stroke: ______ mm

**Run-off precision**
- Supporting guide: ______ μm
- Directional guide: ______ μm
- [ ] Determined by Zollern

**Installation position**
- [ ] Horizontal
- [ ] Vertical
- [ ] angular ______°

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**Hydraulic**

- Oil viscosity: VG ______ mm$^2$/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. 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

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**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 7586 95 95 38   Mr. Knaus
Fax +49 7586 95 97 15
eMail michael.knaus@zollern.de

Mode of drive
- Built-in motor
- Belt drive
- Other

Installation position
- Horizontal
- Vertical
- angular ______°

Application
- Grinding spindle
- Turning spindle
- Workpiece spindle
- Milling spindle
- Test spindle

Operating data
- Spindle speed max.: ______ rpm
- Bearing stiffness radial
  - axial ______ N/µm
- Spindle diameter ______ mm
- Spindle opening ______ mm
- Spindle opening ______ mm

Operating accuracy
- Radial runout ______ µm
- Axial runout ______ µm
- Determined by ZOLLERN

Hydraulic
- Oil viscosity: VG ______ mm²/s at 40°C
- Pump pressure ______ bar
- Oil inlet temperature: min. ______
  - 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.

ZOLLERN HYDROSTATIC BEARING SYSTEMS
## Plants of the Zollern group of companies

<table>
<thead>
<tr>
<th>Location</th>
<th>Division</th>
<th>Address</th>
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- Project meetings on-site and plant inspections
- Detailed, binding offers