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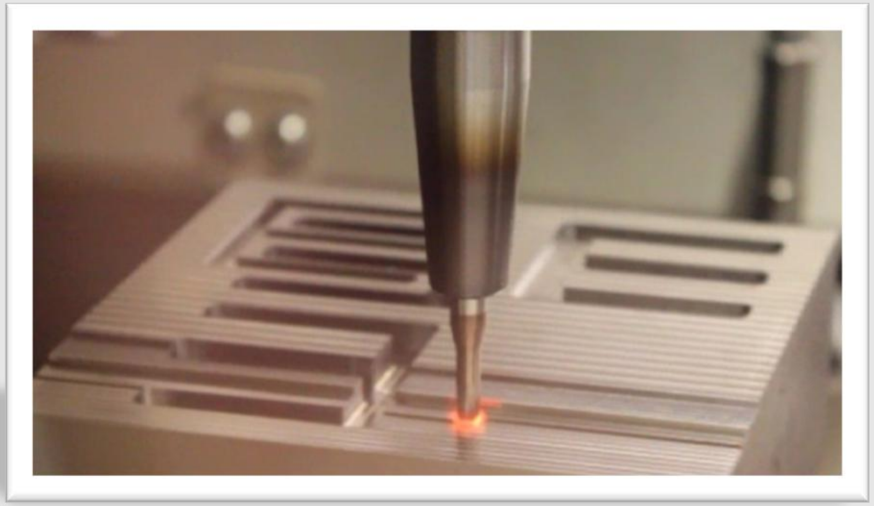
Levicron GmbH
Sauerwiesen 6
D-67661 Kaiserslautern
Tel.: +49 (0) 6301 - 66800 - 0
Fax: +49 (0) 6301 - 66800 - 910
info@levicron.com
http://levicron.com

ULTRA-PRECISION MEETS CNC-PERFORMANCE

- **Upcoming tradeshows 2017** – ***EMO**, Hannover; **ASPE** Annual Meeting, Charlotte, USA*
- **High-Pessure Aerostatic Bearing Technology** – *New tool spindle development **UASD-H25/A** and **UASD-H40***



Upcoming tradeshows

We are looking forwards to seeing you a tour booth on the following upcoming tradeshows:

EMO, Hannover, September 18 - 23, booth E22, Hall 12

EMO Hannover 18-23·9·2017

At this year's EMO exhibition we will also have our new tool spindle developments UASD-H25/A and UASD-H40 with our new high-pressure aerostatic technology on display. As a derivative of our well-known ASD-H25/A our brand new UASD-H25/A works on 20 – 30 bar bearing supply pressure what gives 300 % load capacity compared to the standard version ASD-H25/A that works on 6 – 10 bar supply pressure. This now allows the machining of hardened steel at higher chip loads and rough high-speed machining of copper, e.g. Error-motion, dynamics and thermal stability on the other hand are not affected by these modifications and allow ultra-precision machining of optical components like the customer are used to know with our ASD-H25/A.

Our sales team and Dr. Engmann from our R&D department would be happy to welcome you at our booth E22 in Hall 12 in the time from September 18 – 23.

Read more on http://www.emo-hannover.de/home

32nd ASPE Annual Meeting, Charlotte, USA

This year's annual ASPE conference will be held in Charlotte, NC. In session #8 on Thursday, November 2nd, Ralf Dupont will present our new high-pressure aerostatic technology to combine robustness, speed and low-level error motion for motor spindles in a more scientific way.

The conference will be dealing with new ways and approaches in precision machining, metrology and Nano-Technology.

Get more information about ASPE and the meeting in Charlotte, NC, on http://aspe.net/technical-meetings/32nd-annual-meeting/

Company Precitech will also be hosting Levicron in their exhibition booth. Precitech is an international leading force in ultra-precision machining solutions and represent Levicron products for ultra-precision machining in the Americas and Asia.

We are looking forward to seeing you at the conference and welcome you to Precitech's booth.

High-Pressure-Aerostatic Bearing Technology

The lack of reliability at higher speeds, changing properties and high errors in shaft motion prevent roller bearing spindles from being used for the machining of optical components or high-precision parts that include small features. Although the robustness and the relative low errors in shaft motion of spindles with oil-hydrostatic bearings allows precision-precision machining, such a spindle would create tremendous power losses at higher spindle speeds and requires a very high up front investments and complex sealing technology and leave the end-customer with high running costs. This limits the use of this spindle type to specific applications.

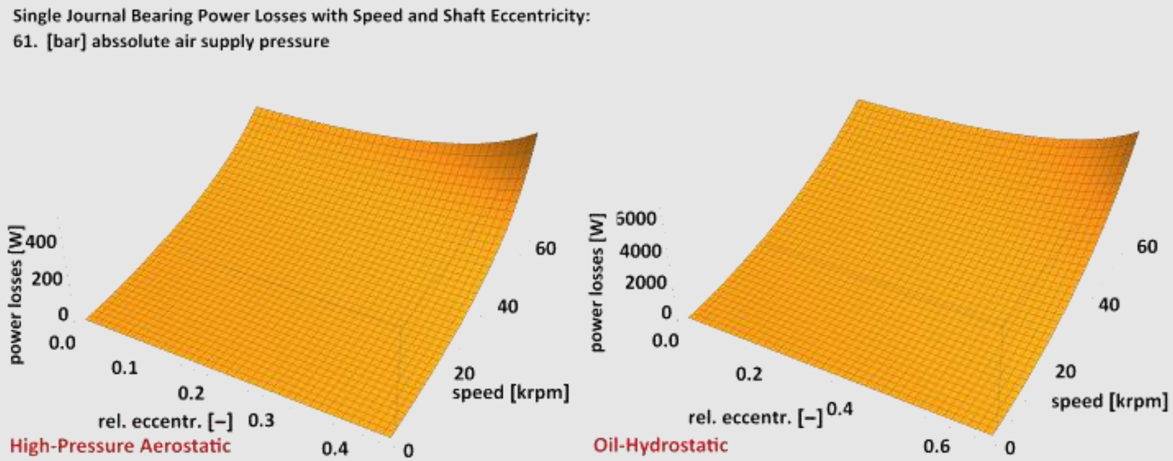


Fig. 1: Shear-losses of a journal bearing with speed and rela. shaft eccentricity using aerostatic bearing technology (left) and oil-hydrostatic bearing technologies (right) for same bearing dimensions (oil-hydrostatic bearing gap 7 x larger)

Using an optimized bearing orifice design with aerostatic bearings allows an almost proportional increase in load capacity with bearing supply pressure. This finally leads to load capacities known from oil-hydrostatic spindles at the same supply pressure. The simplistic sealing technology and the smaller distance from the tool tip to the front radial bearing of the spindle results in a further increase of allowed side load at the tool.

As the shear losses *Pj* in fluid and gas bearings under shaft rotation predominantly depend on the viscosity μ of the fluid or gas that is used, but not much on pressure, bearing losses are almost invariant to supply pressure.

$$(1)\quad P_j = \frac{\mu\, \pi\, D^3\, L\, \omega^2}{4\, h_0}$$

Eqn. (1) shows simplified that the shear losses of gas and fluid journal bearings are invariant to the supply pressure.

Along with the increase in supply pressure to an aerostatic bearing that comprise state of the art bearing orifices also its air consumption increases proportionally. This would lead to an unacceptable air consumption of an aerostatic spindle of up to 1.000 Nl/min at 60 bar supply pressure. Instead of orifices Levicron's worldwide patented bearing technology allows the economical manufacture of very small capillaries of under 30 microns in diameter of which 4-8 times more are used as in standard bearings.

With this not only air consumption could be reduced by more than 70 %, surprisingly load capacity and stiffness increaded at large shaft eccentricities where larger orifices would need to operate in choked conditions.

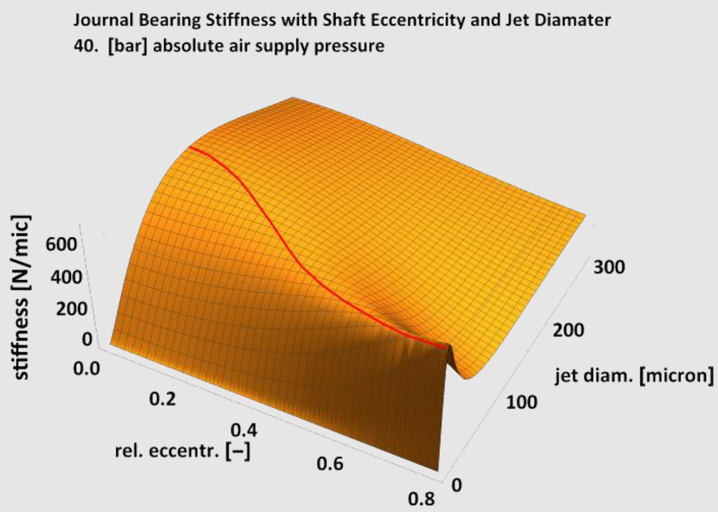


Fig. 2: Stiffness of an aerostatic journal bearing with orifice diameter and relative shaft eccentricity

Only downside is a slightly lower bearing stiffness at concentric shaft conditions.

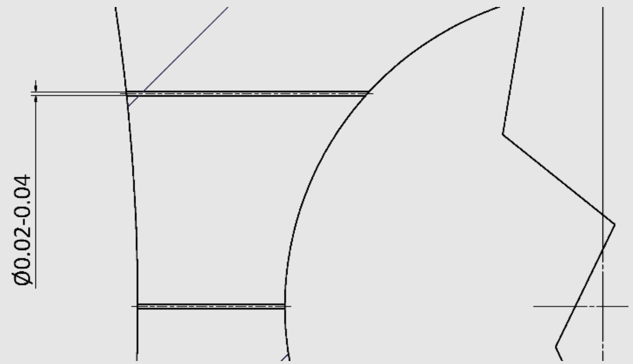


Fig. 3: Capillary bearing design

Based on this approach Levicron has developed their high-pressure Aerostatic spindle technology that gives load capacities like the customers know from oil-hydrostatic bearing, but at a speed, power consumption and error-motion level of spindles with aerostatic bearing systems. Our new spindle developments UASD-H40, featuring a brand new and patented automatic and spring-less HSK-E40 tool interface, and our UASD-H25/A, as a derivation of the well-known ASD-H25/A, feature the new high-pressure aerostatic spindle technology to combine robustness and industry standards with ultra-precision properties and high-speed capability.

UASD-H25/A – fast, accurate and stable as usual, but with three times the load capacity

Beside other spindle models our brand new UASD-H25/A will be on display at this year's EMO exhibition. Based on our well-known ASD-H25/A this spindle comes with the new high-pressure aerostatic bearing technology and combines 200 % higher load capacity with the speed, error-motion and stability known from the standard pressure model. Machining steel under moderate chip load with larger tools and high-speed machining of copper material in a new dimension with aerostatic tool spindles becomes reality.

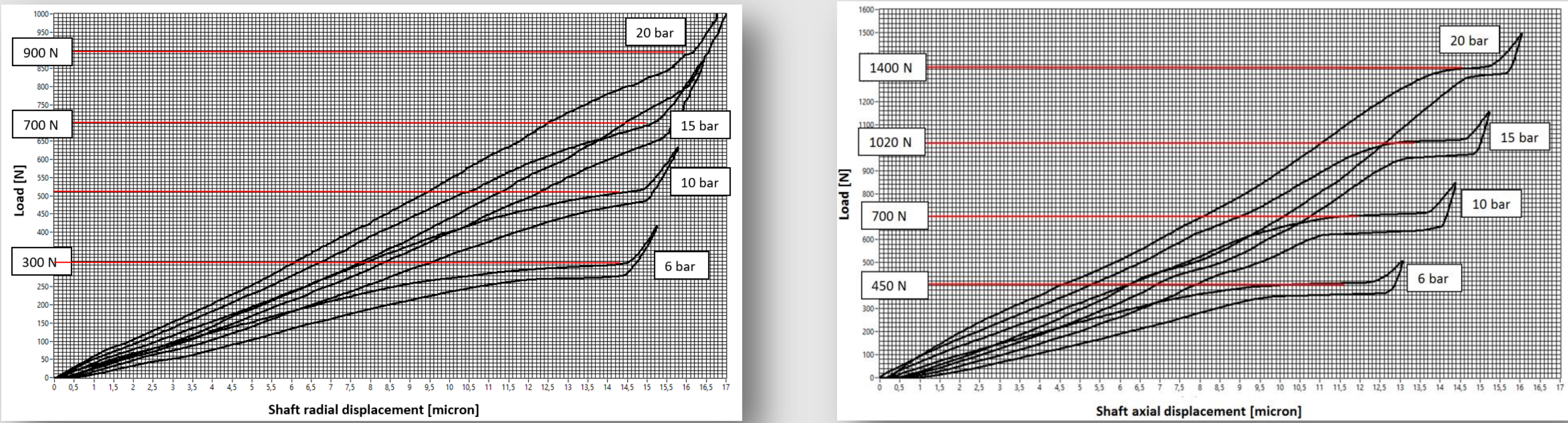


Fig. 4: 200 % increase in radial load capacity at spindle nose (left) and 150 % in axial direction at only 50 % increase in air consumption

Table 1: Direct comparison spindle type ASD-H25/A and the new UASD-H25

		ASD060H25/A	UASD060H25/A
Supply pressure	[bar]	6	20
Speed	[krpm]	0 - 60	0 – 60
Ult. load capacity at spindle nose, radial	[N]	330	900 (275 %)
Ult. Load capacity , axial	[N]	550	1400 (255 %)
Static stiffness, radial	[N/µm]	41	83 (202 %)
Static stiffness, axial	[N/µm]	65	120 (185 %)
Static air consumtion	[Nl/min]	50	90 (180 %)
Dynamic run-out at tool	[µm]	< 0.4	< 0.3
Error in shaft rotation	[nm]	< 23 nm	< 28 nm

The capillary bearing technology, a new axial bearing design and a different connector for the air supply are the only things required to run our ASD-H25/A on 20 – 30 bar supply pressure and to turn this spindle into our UASD-H25/A with only 50 % more air consumption.

Both, the static load capacities and the spindle performance have been verified in machining trials.

Several off-the-shelf compressor solutions are available for our high-pressure aerostatic spindle models. Feel free to contact us or visit http://levicron.com for more information.

UASD-H40 – Full-range machining with HSK-E40 tool interface

The new UASD-H40 spindle development not only features the new high-pressure aerostatic bearing technology to give 3.5 kN radial load capacity at the spindle nose and 5 kN in axial direction, it also features brand a brand new and patented spring-less HSK-E40 tool interface and other pioneering improvements in industrial tool spindle technology.

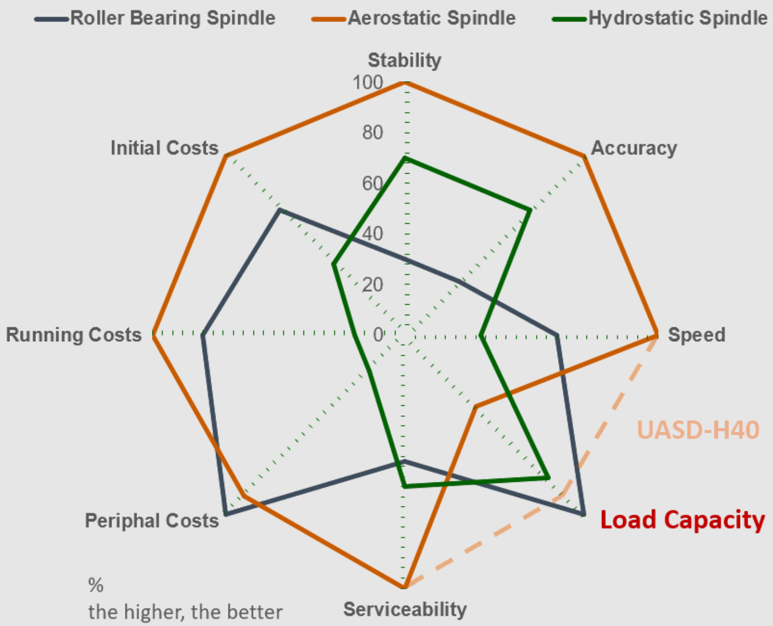


Fig. 5: Relative comparison of available spindle solutions and UASD-H40 as a key component for full-range CNC machining

The patented spring-less HSK-E40 tool interface of our UASD-H40 reduces the number of movable and with the shaft spinning parts to only two. This not only guarantees a safe tool holding for speeds that are 50 % higher than the industry standard, but also an outstanding repeatability, consistent shaft dynamics and a wear-free operation. The clamping system can also feature a new developed rotary feedthrough that allows cutting fluid, air or even vacuum to be guides to the tool tip.

Table 2: Direct comparison of the UASD-H40 spindle development with the industry standard for tool spindles with HSK-E40 tool interface

	Industry Standard	UASD060H40
Tool Interface [-/-]	HSK-E40	HSK-E40
Spindle Diameter [mm]	120	120
Max. Speed [rpm]	42.000	60.000
*) Radial Stiffness, concentric Shaft [N/µm]	100 – 200	120
*) Radial Stiffness, 80% shaft eccentric. [N/µm]	n.a.	400
*) Radial load capacity [N]	max. 4.000	max. 3.500
*) Axial load capacity [N]	max. 3.000	max. 5.000
Thermal Shaft Growth [µm]	20 – 50	< 5
Maintenance interval [h]	4.000 – 8.000	∞
Wear-free [-/-]	No	Yes
Max. speed cont. operation	No	Yes
Motor Torque [Nm]	3 – 5	4, continuous
Max. Shaft Power S1 [kW]	8 – 12	11
IKZ pressure, absol. [bar]	1 – 60	0 – 60
Air consumption [Nl/min]	100	250