

Technical information, notes

Important technical notes and background information on MAPAL clamping technology are given in the following.

Along with the standards on HSK-A, HSK-C, HSK-T as well as the various SK variants, the fitting dimensions for the flange modules are documented. There are then important technical notes on the individual clamping tools and clamping systems in the catalogue.

The performance data on the KS clamping cartridges include information on clamping force and bending moment. The torques that can be transferred, radial run-out accuracy and accuracy of repetition as well as the spindle speed limits for the HSK connection are also explained.

After the definition, calculation, effect and limits of balancing, there follows information on the coding system for hollow taper shanks provided by MAPAL as an option to prevent operating errors during a tool change.

Chucks

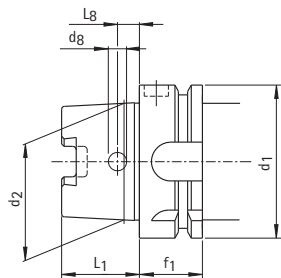
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Finally, there are helpful practical tips with notes on setting and handling related to the installation and assembly of the KS clamping cartridge, as well as the assembly and alignment of KS flange adapters and MAPAL Module connections.

Standards and fitting dimensions

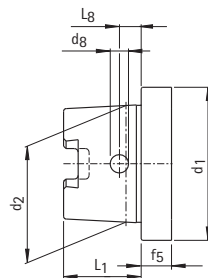
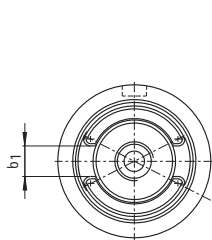
HSK standard

For hollow shanks DIN 69893-1 HSK-A, HSK-C and HSK-T



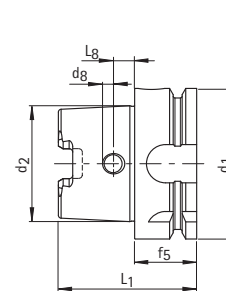
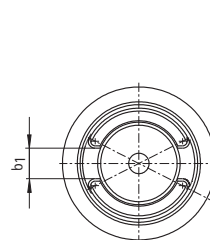
HSK-A

for automatic and manual tool change



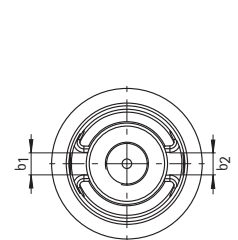
HSK-C

for manual tool change



HSK-T

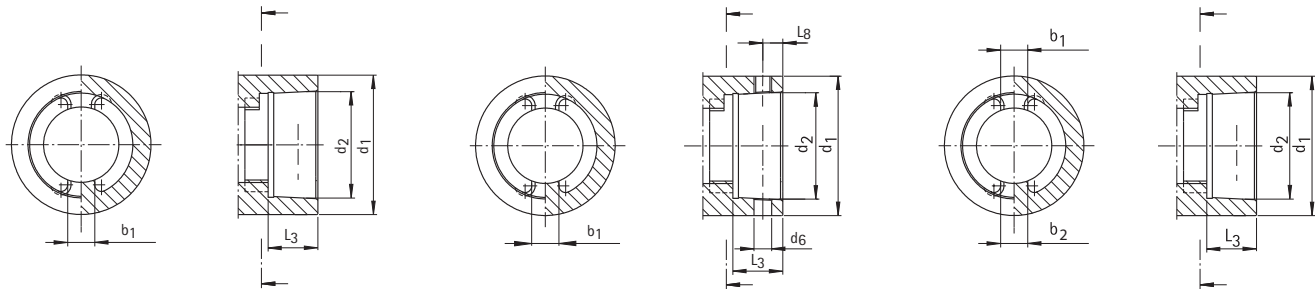
for automatic and manual tool change



		HSK size					
Nominal size	d_1 h10	32	40	50	63	80	100
Taper diameter	d_2	24,007	30,007	38,009	48,01	60,012	75,013
Shank length	L_1 0/-0.2	16	20	25	32	40	50
Slot width	b_1 +/-0.04	7,05	8,05	10,54	12,54	16,04	20,02
Bore diameter	d_8	4	4,6	6	7,5	8,5	12
Bore spacing	L_8 +/-0.1	5	6	7,5	9	12	15
Flange width HSK-A	f_1 0/-0.1	20	20	26	26	26	29
Flange width HSK-C	f_5	10	10	12,5	12,5	16	16
Additional for HSK-T							
Slot width	b_2 +/-0.030	-	7,932	-	-	-	-
Slot width	b_2 +/-0.0350	-	-	-	12,425	-	19,91

Dimensions in mm.

For connections DIN 69093-1 HSK-A, HSK-C and HSK-T



HSK-A
for automatic tool change

HSK-C
for manual tool change

HSK-T
for automatic and manual tool change

		HSK size					
Nominal size	d_1	32	40	50	63	80	100
Taper diameter	d_2	23,998	29,998	37,998	47,998	59,997	74,997
Depth	$L_3 + 0.2$	11,4	14,4	17,9	22,4	28,4	35,4
Driving element width	$b_1 \pm 0.05$	6,8	7,8	10,3	12,3	15,8	19,78

Additional for HSK-C

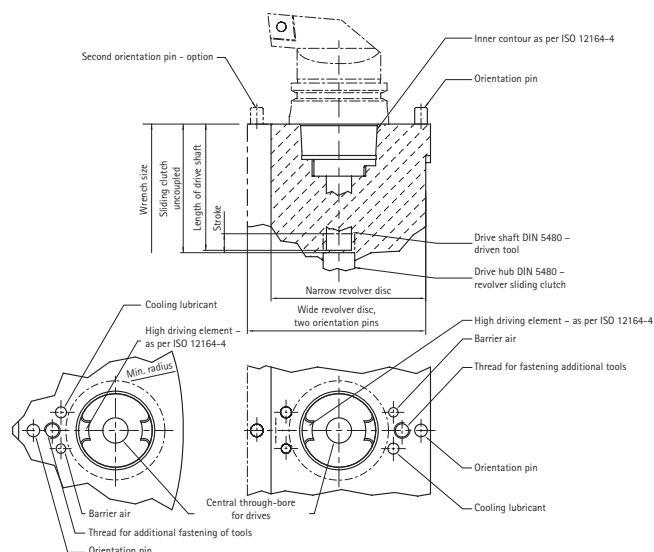
Bore diameter	d_6	4	5	6	8	9	11
Bore spacing	$L_8 \pm 0.1$	5	6	7,5	9	12	15

Additional for HSK-T

Driving element width	$b_2 - 0.025$	–	7,92	–	12,41	–	–
Driving element width	$b_2 - 0.03$	–	–	–	–	–	19,98

Dimensions in mm.

In addition to the standard, the connection of driven tools using the HSK-T interface has been adopted.



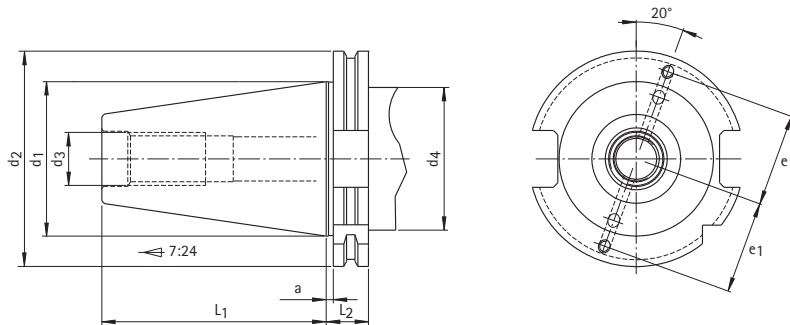
The following definitions were also established in the HSK-T working group:

- Diameter of the drive shaft
- Drive shaft coupling type
- Position of the coupling
- Revolver wrench size
- Related HSK size
- Transfer point for cooling lubricants and barrier air
- Additional alignment feature for angled tool adapters

Standards and fitting dimensions

ISO standard

For steep taper shanks in accordance with DIN 69871

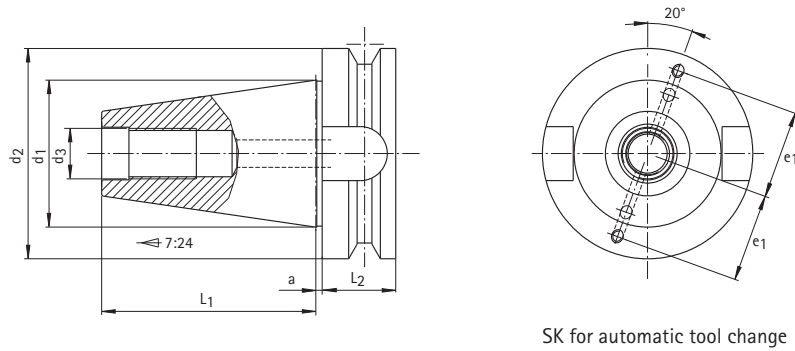


ISO for automatic tool change Form A, Form AD, Form B and design with data carrier

	Steep taper size			
	30	40	45	50
$a \pm 0,1$	3,2	3,2	3,2	3,2
d_1	31,75	44,45	57,15	69,85
$d_2 \ 0/-0,1$	50	63,55	82,55	97,5
d_3	M 12	M 16	M 20	M 24
$d_4 \text{ max.}$	45	50	63	80
$e_1 \pm 0,1$	21	27	35	42
$L_1 \ 0/-0,3$	47,8	68,4	82,7	101,75
$L_2 \ 0/-0,1$	19,1	19,1	19,1	19,1

Dimensions in mm.

For steep taper shanks BT in accordance with JIS 6339



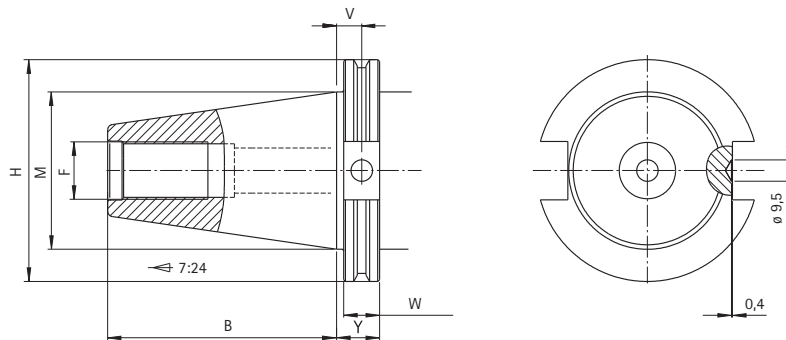
	Steep taper size		
	30	40	50
a $\pm 0,4$	2	2	3
d ₁	31,75	44,45	69,85
d ₂ h8	46	63	100
d ₃	M 12	M 16	M 24
e ₁ $\pm 0,1$	21	27	42
L ₁ $\pm 0,2$	48,4	65,4	101,8
L ₂ min.	20	25	35

Dimensions in mm.

Standards and fitting dimensions

SK standard

For steep taper shanks with V-flange module in accordance with ASME B5.50-1994 (MN633)



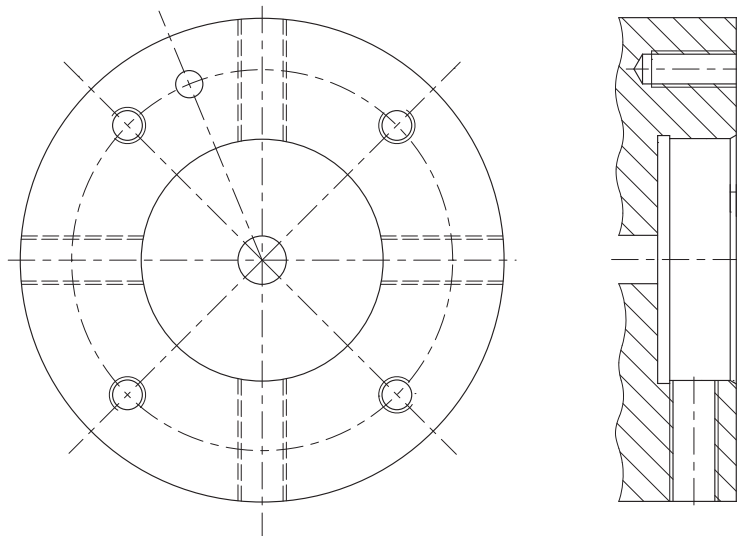
		Steep taper size			
		30	40	45	50
B	+/-0,1	47,65	68,25	82,55	101,6
F	UNC-2B	1/2"-13	5/8"-11	3/4"-10	1"-8
H	+/-0,5	46,02	63,5	82,55	98,43
M	+/-0,13	31,75	44,45	57,15	69,85
V	+/-0,25	11,2	11,2	11,2	11,2
W	+/-0,05	15,88	15,88	15,88	15,88
Y	+/-0,05	19,05	19,05	19,05	19,05

Dimensions in mm.

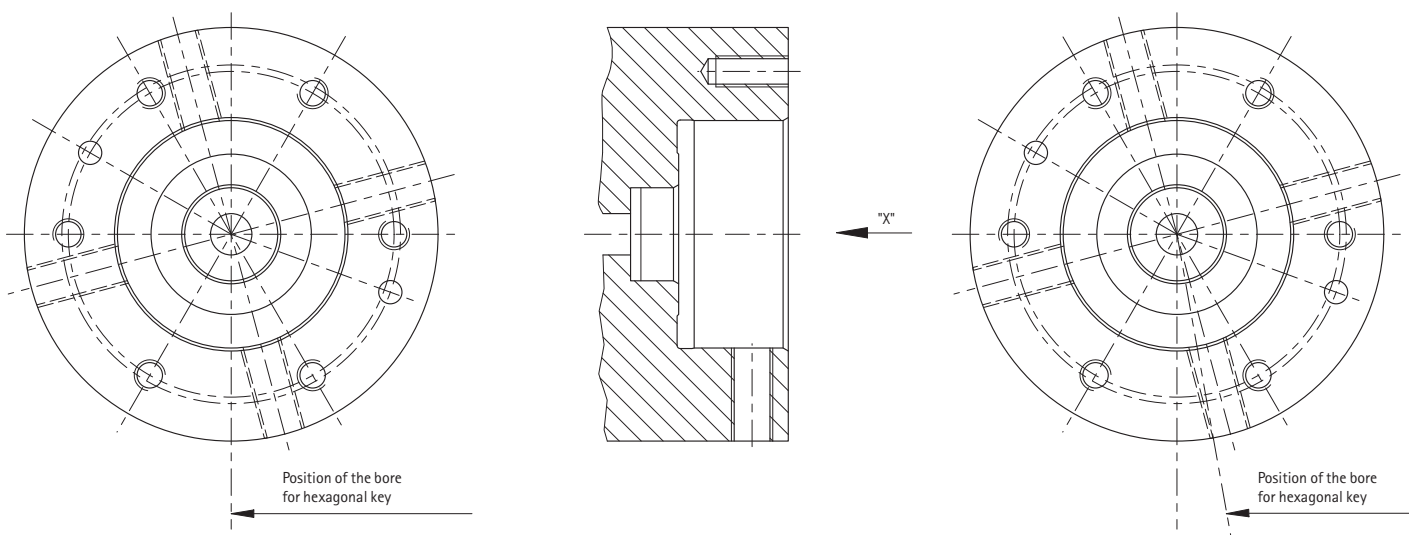
Standards and fitting dimensions

Fitting dimensions for KS flanges

Spindle connection contour for flange adapter MN5520* and MN5523* in accordance with



Spindle connection contour for adapter flange MN5521* and MN5524* in accordance with MN5000-12

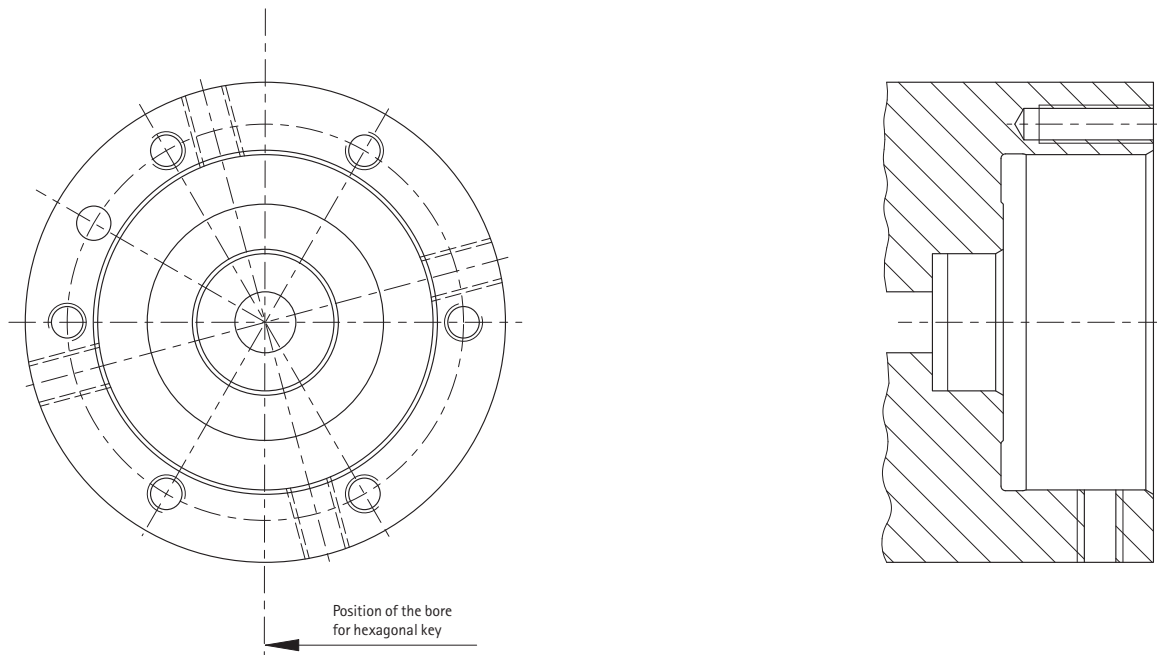


* Due to possible technical changes, we recommend requesting the latest manufacturing documentation if needed. You will find an overview on this aspect on page 256.

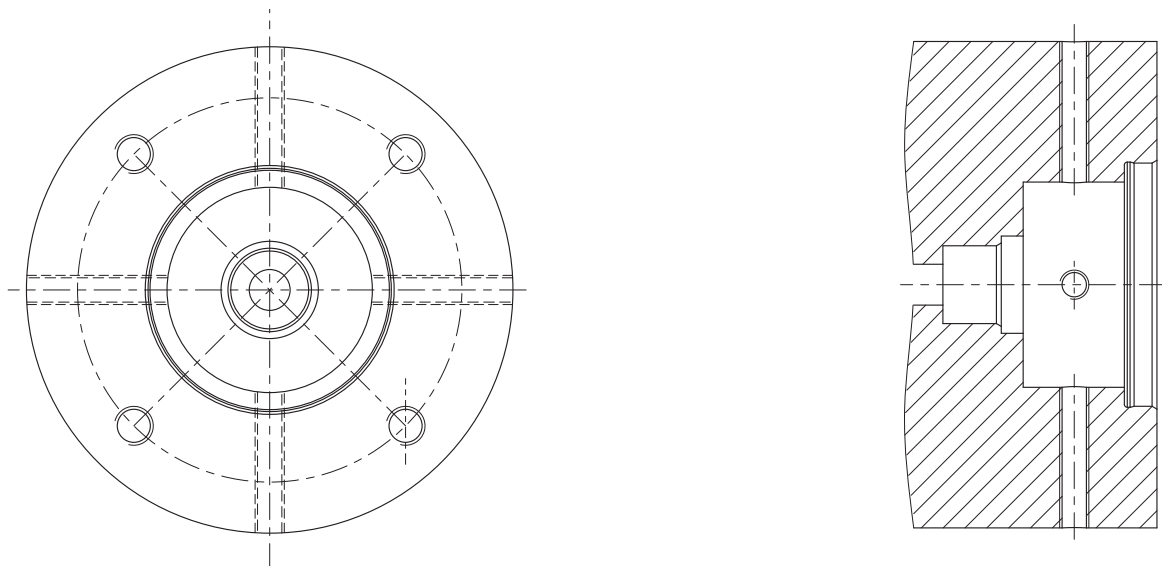
Standards and fitting dimensions

Fitting dimensions for KS flanges

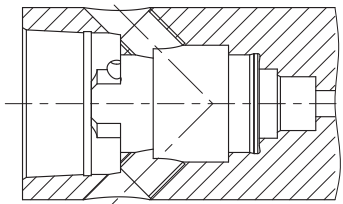
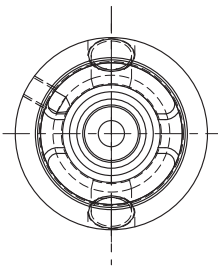
Spindle connection contour for adapter flange for short spindles MN5522* in accordance with MN5000-13



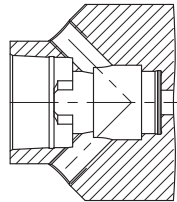
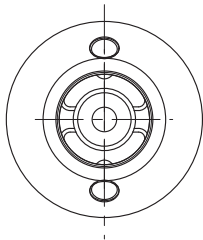
Spindle connection contour for DS clamping system with reduced installation in accordance with MN5000-73*



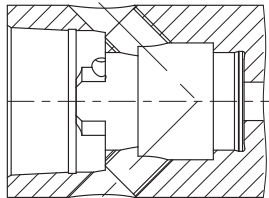
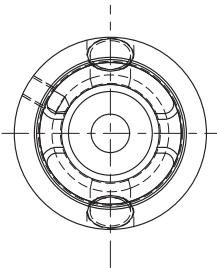
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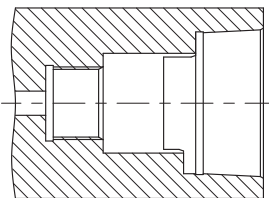
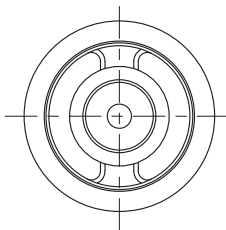
Internal spindle contour
for DS clamping system,
direct installation*



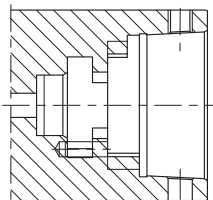
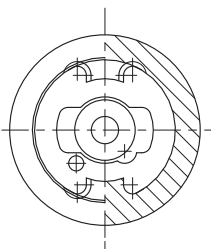
Internal spindle contour
for DS clamping system,
direct installation, without
internal coolant supply*



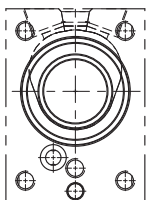
Internal spindle contour
for DS clamping system,
direct installation, with stop
ring, without coolant supply*



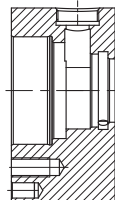
Spindle connection contour
for AX clamping system in
accordance with MN5000-77*



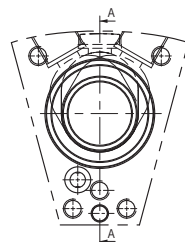
Connection for taper hollow
shanks HSK-T ISO 12164, KS*



Star revolver



Section A-A



Drum revolver

Adapter flange for star
revolvers and drum revolvers*

* Due to possible technical changes, we recommend requesting the latest manufacturing documentation if needed. You will find an overview on this aspect on the next page.

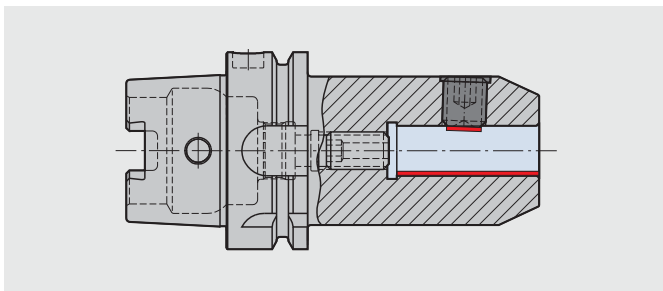
Overview of spindle connection contours

Document	Description
MN5000-12	Internal spindle contour for adapter flange MN5521 and MN5524
MN5000-13	Internal spindle contour for adapter flange MN5522
MN5000-14	Internal spindle contour for adapter flange MN5520 and MN5523
MN5000-40	Hollow shank connection HSK-C DIN 69063-1, KS
MN5000-49	Connection for taper hollow shanks HSK-T ISO 12164, KS
MN5000-50	Adapter flange for star revolvers and drum revolvers
MN5000-72	Adapter flange DS-VF with diagonal clamp and reduced installation space, rotating, connection sizes, W/OIC
MN5000-73	Adapter flange DS-VF with diagonal clamp and reduced installation space, rotating, connection sizes, IC
MN5000-77	Internal spindle contour HSK-C, AX clamping system, direct installation
MN5000-82	Internal spindle contour HSK-C, DS clamping system, direct installation, IC, ring RE
MN5000-83	Internal spindle contour HSK-C, DS clamping system, direct installation, W/OIC, ring RE
MN5000-85	Internal spindle contour HSK-C, DS clamping system version "L", direct installation, W/OIC

Clamping systems and clamping technologies

Mechanical chuck technology

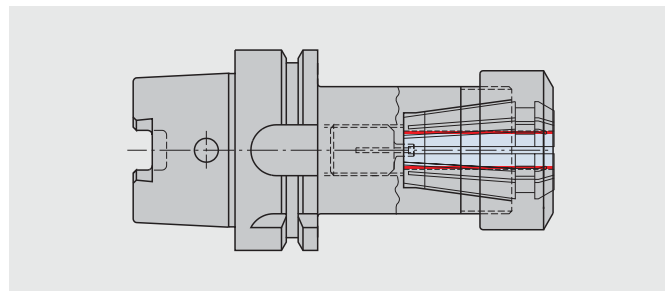
The most economical entry-level variants to tool clamping are mechanical chucks. These chucks feature robustness and simplicity.



1. Cylindrical shanks in accordance with DIN 69882-4/-5

MAPAL has both clamping tools with a lateral drive area and also with an angled clamping surface in its range. Due to the single-sided clamping force action, trade-offs in the radial run-out accuracy must be accepted.

In the steep taper area it is recommendable to clamp MAPAL NC reamers with angled clamping surface via a precision adapter. These special clamping tools are available for SK chucks in accordance with DIN, JIS and ASME. The bore tolerance is reduced to 0.003 mm to be able to reliably achieve the quality requirements placed on MAPAL reaming tools.



2. Collet holders in accordance with DIN 69882-6

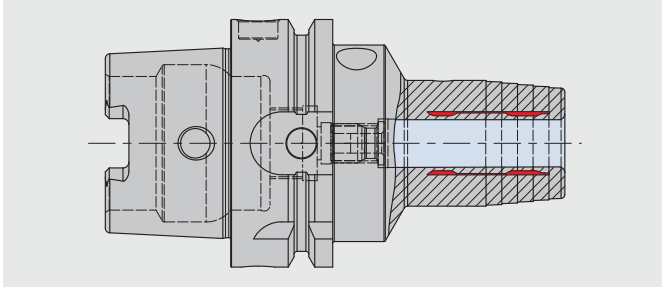
The flexible variant of the mechanical chuck is the solution with a collet. By using appropriate collets a holder can accept tools with a cylindrical shank over an entire clamping diameter range (e.g. clamping range 2 – 20 mm with one clamping tool). Also a collet covers the range from 1 mm in diameter.

The variability of the collet chuck however also involves disadvantages such that trade-offs must be accepted on the collet holder in relation to radial run-out accuracy, maximum possible spindle speed and maximum torque transmission.

Along with conventional collet holders, MAPAL also offers chucks with clamping nuts for internal coolant supply. In combination with ER sealing discs, these Hi-Q/ERC clamping nuts make it possible to also use existing collets for tools with internal coolant supply.

Clamping systems and clamping technologies

Hydraulic clamping technology

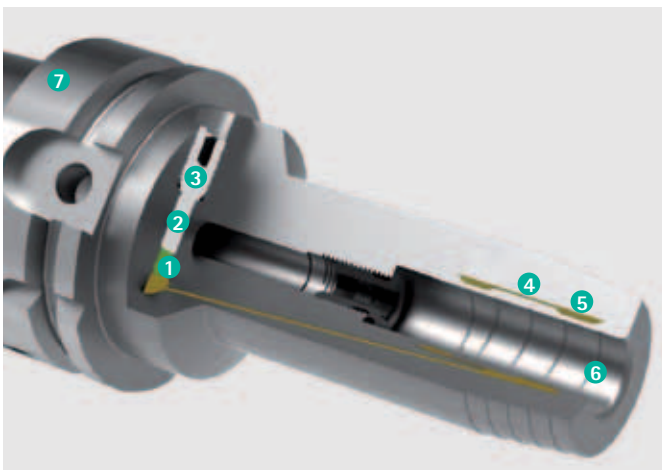


On clamping using hydraulic clamping technology, an even pressure is built up in a sealed chamber system using a clamping screw and a piston. This pressure is applied to the tool via the built-in expanding sleeve.

Advantages:

- ▶ Increased service life of the tool due to very high radial run-out accuracy and accuracy of repetition ($< 0.003 \text{ mm}$); as a consequence even cutting.
- ▶ Improved surface quality on the workpiece; reduced microstructure cracking on the tool cutting edge due to the excellent vibration damping of the hydraulic system.
- ▶ High torque transmission due to displacement of oil, grease and lubricant residue into the groove. As a result the clamping surface remains largely dry.
- ▶ Flexible clamping range due to usage of slotted, intermediate sleeves with coolant seal (radial run-out accuracy of the sleeves $< 0.002 \text{ mm}$).
- ▶ Exact, radial or axial length adjustment.
- ▶ Suitable for MQL.
- ▶ Simple operation and very quick handling:
The tool can be clamped centrally in seconds using a hex wrench.
No peripheral devices are needed for clamping and unclamping.
There is no additional investment or maintenance effort for external components.
- ▶ Sealed clamping system:
There is no maintenance work or additional cost due to soiling
- ▶ Very safe clamping:
No reduction in the clamping forces at high spindle speeds
- ▶ Fine balancing:
All hydraulic chucks are fine balanced as standard for usage on HSC machines.

1. Elements of the clamping technology



- 1 Sealing element:** See page losses in the clamping bore are prevented by the lip seal.
- 2 Piston:** Presses the hydraulic medium into the chamber system.
- 3 Clamping screw:** A torque wrench is not necessary to actuate the piston for clamping.
- 4 Expanding sleeve:** Clamps the tool shank centrally with evenly applied pressure.
- 5 Chamber system:** Is produced by the connection of the expanding sleeve and body. Due to the hydraulic medium has a damping action on the tool and therefore a wear-reducing effect.
- 6 Groove:** Oil, grease or lubricant residue is displaced into the groove by the high clamping pressure. The clamping surfaces remain largely dry, the transmission of the torque is ensured.
- 7 Body:** MAPAL hydraulic chucks are available for all common machine-side connections (HSK-A, HSK-C, SK, BT and flange module).

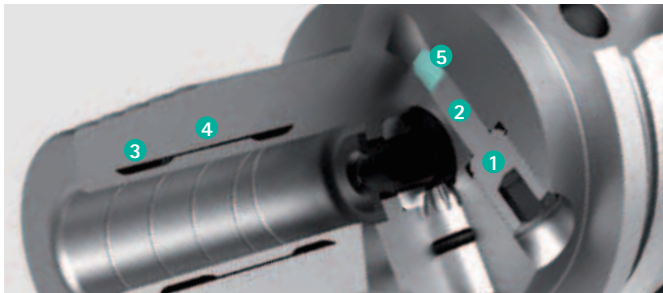
Clamping systems and clamping technologies

Hydraulic clamping technology

Technical data

- Material 1600-1800 N/mm² tensile strength
- Adjustment path 10 mm
- Hardness 52 + 2HRc
- DIN 1835 Form A, B, C, D
- Tool holder balanced
- DIN 6535 Form HA, HB, HE
- Laser labelling
- Coolant pressure maximum 80 bar
- Max. spindle speed 40,000 min⁻¹ (pay attention to spindle speed limit for connection, fine balancing recommended!)
- Optimal operating temperature 20-50 °C; Higher temperatures on request, do not use above 80 °C
- Shanks that can be clamped (tolerance h6) with and without reducing sleeves:
 - DIN 1835 Form A, B, C, D
 - DIN 6535 Form HA, HB, HE

2. Functional principle



- 1 The clamping screw is screwed in to the stop using a hex wrench.
- 2 The piston presses the hydraulic medium into the
- 3 expansion chamber and causes the pressure to increase.
- 4 The thin-walled expanding sleeve bows evenly against the tool shank. Due this clamping process the tool shank is first centred and then powerfully clamped over a large area.
- 5 The special sealing element ensures absolute freedom from leaks and a long service life.

3. Torque transmission

Please refer to the table for the torque that can be transferred.

The torques stated apply for shank lengths in accordance with DIN 6535 and DIN 1835.

a Transferable torques with direct clamping, oiled shank, clamping diameter $d_1 = 6 - 32$ mm

d_1 [mm]	6	8	10	12	14	16	18	20	25	32
For shank h6 minimum / maximum [Nm]	20/30	30/45	47/85	80/140	100/160	160/230	200/270	330/400	400/470	650/730

b Transferable torques, measured with intermediate sleeve, oiled shank, clamping diameter $d_1 = 32$ mm

d_1 [mm]	6	8	10	12	14	16	18	20	25
For shank h6 minimum / maximum [Nm]	30/45	50/65	60/110	120/170	125/170	180/230	220/300	250/320	360/440

Clamping diameter hydraulic chuck $d_1 = 20$ mm

d_1 [mm]	3	4	5	6	7	8	9	10	11	12
For shank h6 minimum / maximum [Nm]	6/10	9/12	16/23	30/40		55/75		90/120		120/150

d_1 [mm]	13	14	15	16	17
For shank h6 minimum / maximum [Nm]		135/170		190/260	

Clamping diameter hydraulic chuck $d_1 = 12$ mm

d_1 [mm]	3	4	5	6	8
For shank h6 minimum / maximum [Nm]	3/4	4/8	7/12	12/20	18/26

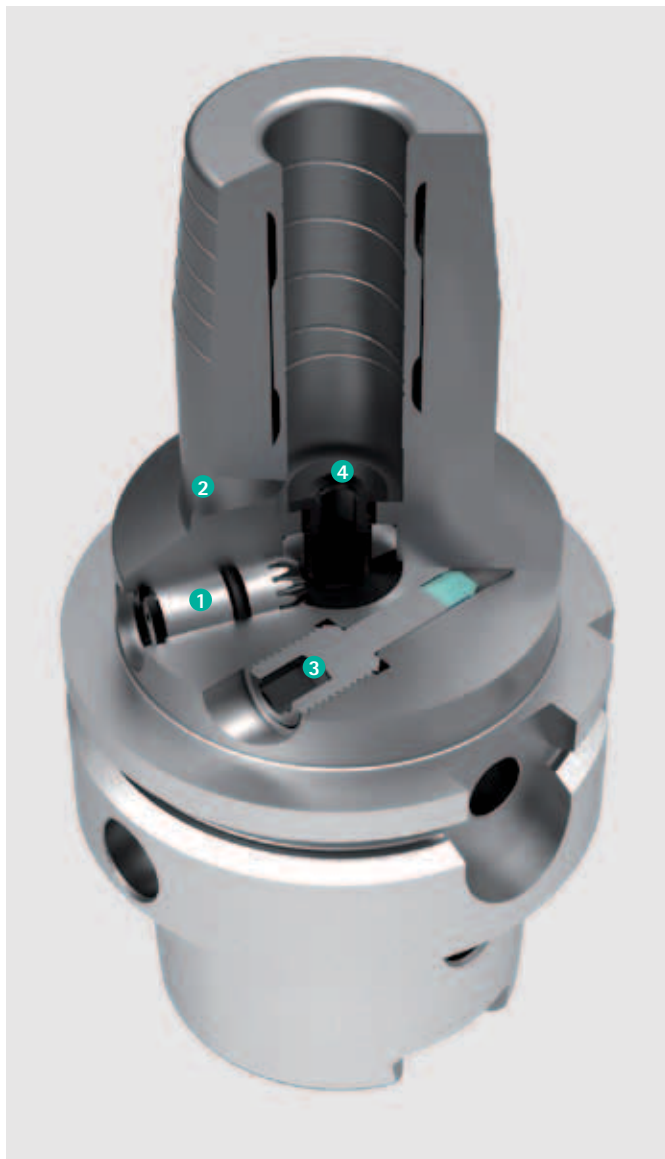
Clamping systems and clamping technologies

Hydraulic clamping technology

In the area of clamping tools with HSK connection, MAPAL also offers hydraulic chucks with radial tool length adjustment. Even with this setting method radial run-out accuracies $< 0.003 \text{ mm}$ are ensured.

4. Radial tool length adjustment

Components of the radial length adjustment



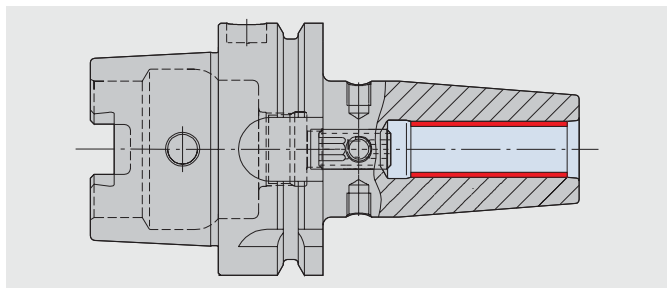
Advantages of the radial length adjustment:

- ▶ Length adjustment to the micron due to compact setting gearing
- ▶ Position of the tool not changed by inherent weight or axial force due to self-locking adjustment screw
- ▶ 10 mm adjustment path for all clamping diameters with adjustment screw stop at the rear
- ▶ Insensitive to soiling
- ▶ Robust mechanism
- ▶ Coolant seal up to 100 bar
- ▶ Easy to use and reliable

- 1 Actuation of the radial length adjustment
- 2 Vent
- 3 Clamping
- 4 Setting screw

Clamping systems and clamping technologies

Shrinking technology

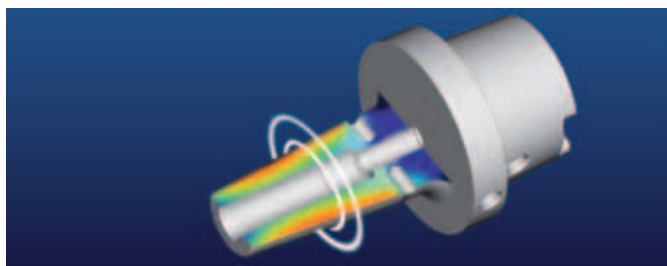


Shrinking technology makes use of thermally-related expansion for tool clamping. An induction coil heats the shrink chuck. The chuck expands, the cold tool shank can be inserted. The shrink chuck is cooled down again, contracts and forms a connection with force closure due to the oversize on the tool shank.

Advantages:

- ▶ High flexibility:
Numerous possible combinations of shrink chucks and extensions
- ▶ Wide range of applications:
High torque transmission and radial stiffness
- ▶ Long service life:
No geometry or structure changes during the heating
- ▶ No maintenance costs:
Sealed system, as a result no soiling
- ▶ High dimensional accuracy at the workpiece:
Long-term radial run-out accuracy and accuracy of repetition of $< 0.003 \text{ mm}$ in the location bore.
- ▶ Long tool service lives and surface qualities:
Fine balanced as standard.

Functional principle



1. Heating the chuck

The chuck is heated specifically at the clamping point using the latest induction technology. For this purpose an induction coil generates quickly changing eddy currents that act directly on the shrink chuck and heat exactly in the place where the tool shank sits. The diameter of the bore expands.

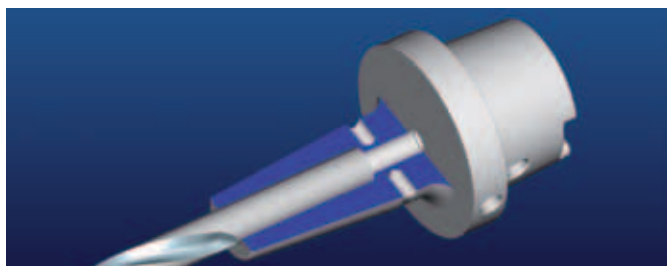
2. Fitting the tool shank

The cold tool shank is inserted in the heated shrink chuck.

3. Cooling

The shrink chuck is cooled, the clamping diameter returns to its original size and clamps the tool shank.

A powerful device with water-cooled cooling elements makes it possible to cool the chuck within 30 seconds. As a consequence there is no heating of the taper or the data chip. It is possible to cool extensions and non-standard shrink chucks using adapters that can be fitted to the cooling element.



The result:

Tool changes can be realised in seconds due to the inductive heating. Shrink chuck, if necessary the tool extension, and tool shank form a joint with force closure. It is possible perfectly clamp carbide as well as HSS tools. The tools sits highly accurately with maximum clamping force in the tool adapter.

Precision-DrillChuck



Advantages:

- ▶ The precision drill chuck from MAPAL combines robustness, easy to repair mechanical functions and straightforward handling with particularly advanced technology.
- ▶ Precision, as demanded by designers, production planners and the market, is achieved by improved radial run-out accuracy and significantly higher clamping force.
- ▶ Safe clamping independent of direction of rotation, short clamping and re-tooling times, very short designs and excellent spindle speed strength are the most impressive features.
- ▶ The construction, the precise manufacture and the unmistakable design set standards.
- ▶ Due to their modular design the drill chuck heads are suitable for all tool connections.

Technical data

Clamping range	0.3 – 8 mm	0.5 – 13 mm	2.5 – 16 mm
Max. run-out variation (at a tightening torque)	0.03 mm (*) of 8 Nm	0.03 mm (*) of 15 Nm	0.03 mm (*) of 15 Nm
Holding torque (at a tightening torque)	30 Nm (**) of 10 Nm	40 Nm (**) of 15 Nm	45 Nm (**) of 15 Nm
Max. perm. tightening torque	10 Nm	20 Nm	20 Nm
Holding torque (at a tightening torque)		80 Nm (**) of 20 Nm	90 Nm (**) of 20 Nm
Max. perm. spindle speed	35,000 min ⁻¹ (***)	35,000 min ⁻¹ (***)	35,000 min ⁻¹ (***)

(*) Run-out variation check as per MAPAL "Precision" inspection report.

(**) All precision drill chucks are clamped at the side using a hexagonal T-key via a bevel gear (see operating manual).

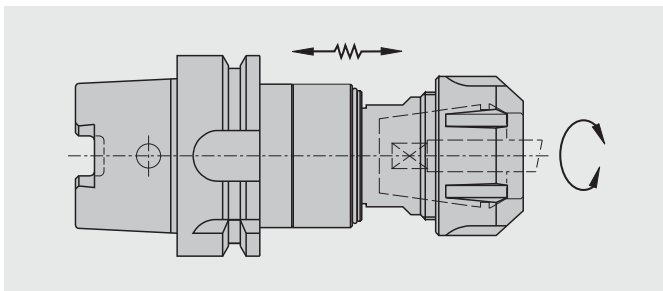
A tightening torque of 8 Nm or 15 Nm on the hexagonal T-key is adequate for the usage of the drill chuck. The higher holding torques that can be achieved with the precision drill chucks are to be considered an additional safety margin and are not necessary for normal usage.

(***) "Unbalanced", the precision drill chucks are suitable for use up to 7,000 min⁻¹.

For usage at spindle speeds from 7,000 min⁻¹ up to 35,000 min⁻¹ (e.g. for machining aluminium or wood) the drill chucks must also be balanced as per the balancing classes – taking into account the application and balancing quality.

Clamping systems and clamping technologies

Softsynchro® tapping chuck technology



1. Softsynchro® tapping chuck

The synchronisation of the rotary movement of the spindle and feed axis make it possible to manufacture threads using tools without length compensation. Nevertheless, in practice synchronisation errors can often not be completely avoided. The reasons for this problem are the machine dynamics and the interaction of the spindle drive and linear drive.

Tolerances on the tapping tool also play a role.

On the usage of rigid tools, these synchronisation errors result in high axial forces and as a consequence reduced tool lives along with untidy threads and thread flanks that do not fit the gauges.

Collet holders of the type Softsynchro® act as a damping element between the synchronous spindle and tapping tool and therefore make optimal use of the synchronous spindle. The best tool lives and surface qualities are possible.



The MAPAL range includes Softsynchro® tapping chucks with HSK-A connection as well as with cylindrical shank in accordance with DIN 1835 B + E.

Advantages:

- ▶ Compensation of pitch differences between synchronous spindle and tapping tool
- ▶ High radial run-out accuracies
- ▶ Firm clamping by means of collets with square holder
- ▶ No special shanks necessary on the tool
- ▶ High process reliability during synchronous thread cutting

Clamping systems and clamping technologies

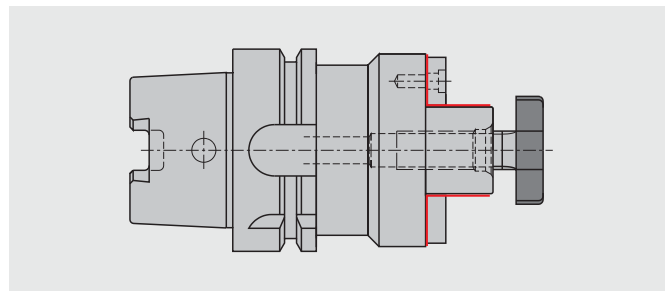
Softsynchro® tapping chuck technology and milling cutter arbors



Softsynchro® tapping chuck

Layout of the Softsynchro® tapping chuck:

- ▶ 2-piece (chuck shank/tool connection):
Easy to dismantle, straightforward maintenance
- ▶ Axial force compensation and torque separated:
Hardly any interaction
- ▶ Pre-loaded plastic damping elements: No effect on the tool cutting edge due to rising axial vibration
Axial movement only after exceeding the preload
- ▶ Longitudinal movement guided by balls:
Less rolling friction, very good response
- ▶ Suitable for internal cooling up to 50 bar:
Axial force not affected by cooling lubricant pressure, therefore no longitudinal movement.



2. Milling cutter arbors in accordance with DIN 69882-3

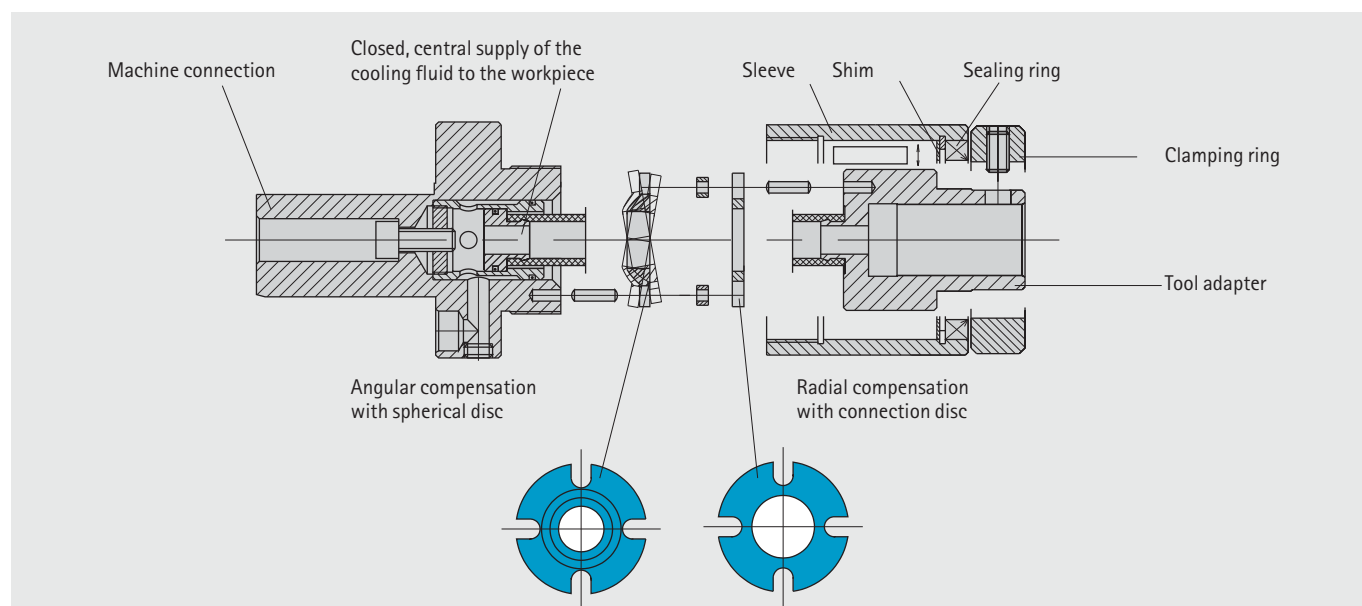
A proven clamping system for the connection of cutter heads, shell end face milling cutters and single angle shell end milling cutters.

Clamping systems and clamping technologies

MAPAL floating holders

1. Design elements

- ▶ Sliding surface contact:
Flat sliding surfaces transmit the axial feed forces with low surface pressure.
- ▶ Reliable function:
Even at feed rates common today and the related high forces.
- ▶ Straightforward radial and angular adjustment of the tool adapter with lasting high accuracy.
- ▶ Radial and angular compensation is ensured by pre-defined play in the design.
- ▶ The surface contact is a particularly advantageous element of the design compared to conventional point contact.
- ▶ Closed, central supply of the coolant (water, oil, air) to the workpiece via a flexible sealed component that is connected to the tool holder and the tool adapter.



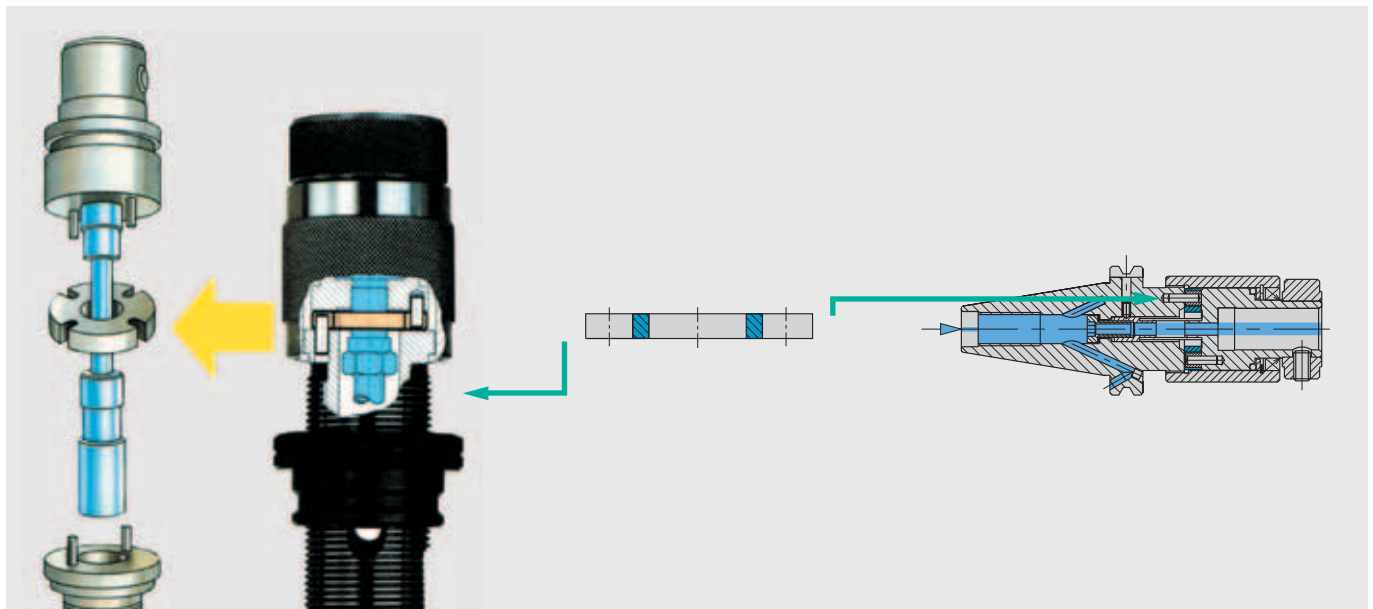
Clamping systems and clamping technologies

MAPAL floating holders

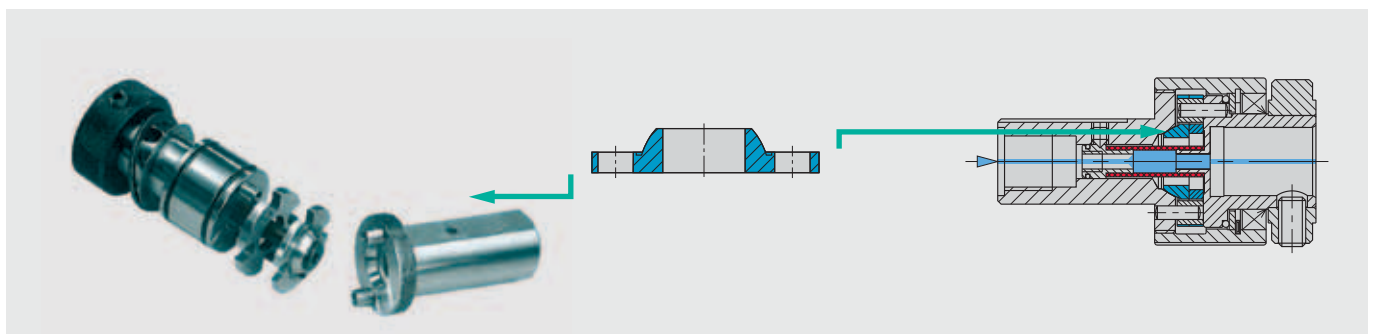
2. Compensation variants

Two different types of floating holder differ in the offset compensation method:

Type PR has **sliding surface contact** via which the axial feed forces are transmitted with low surface pressure.

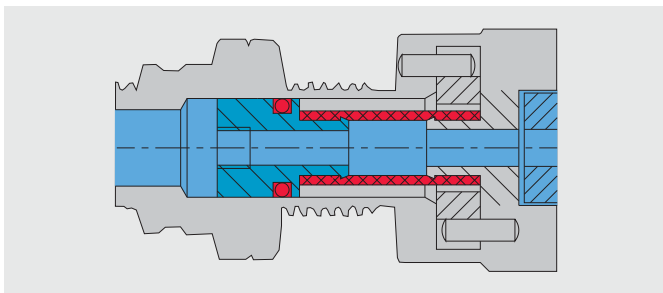


Type PA has a **second movement plane** by means of which the angular offset is compensated by a spherical disc and conical seat.



Clamping systems and clamping technologies

MAPAL floating holders

**3. Coolant supply**

MAPAL floating holders feature a closed, central supply of coolant (water, air, oil) to the workpiece via a flexible, sealed component that is connected to the tool holder and the tool adapter.

There exist the following three connection variants:

1. Supply at the end of the floating holder

Maximum possible coolant pressure 50 bar.

Model:

KZ (central coolant supply)

2. Supply via side bore

Maximum possible coolant pressure 50 bar.

Model:

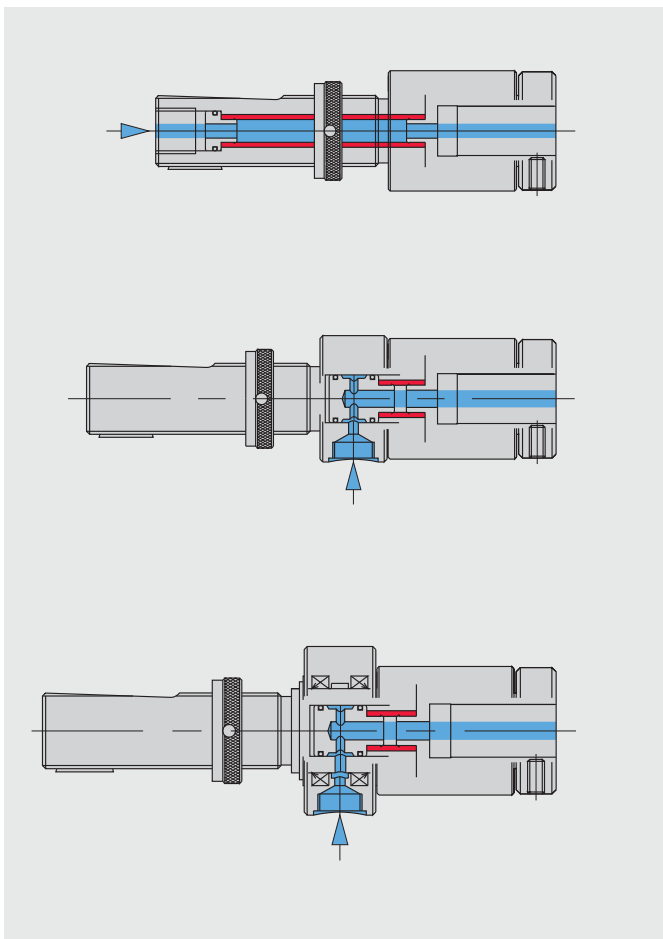
KZB (coolant supply via side bore)

3. Supply via rotating ring

Maximum possible coolant pressure 30 bar.

Model:

KZD (central coolant supply via rotating ring)

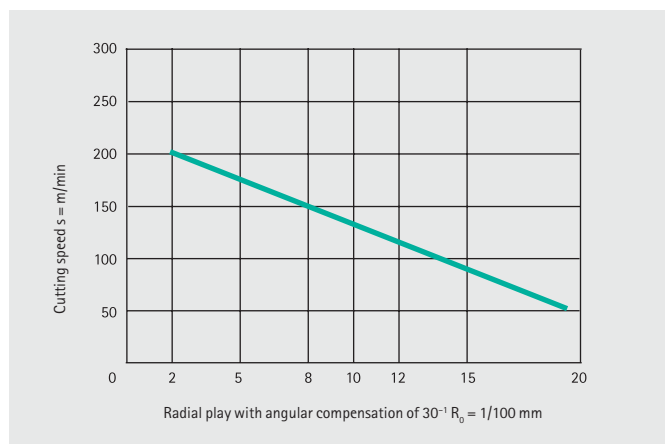
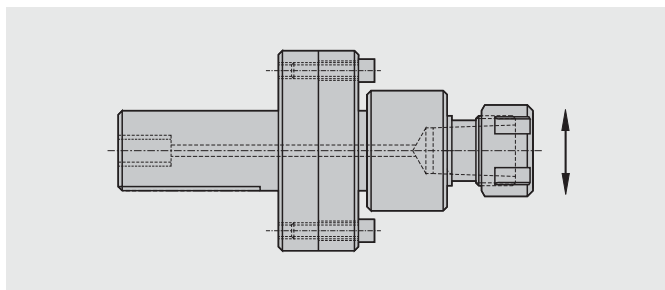


Clamping systems and clamping technologies

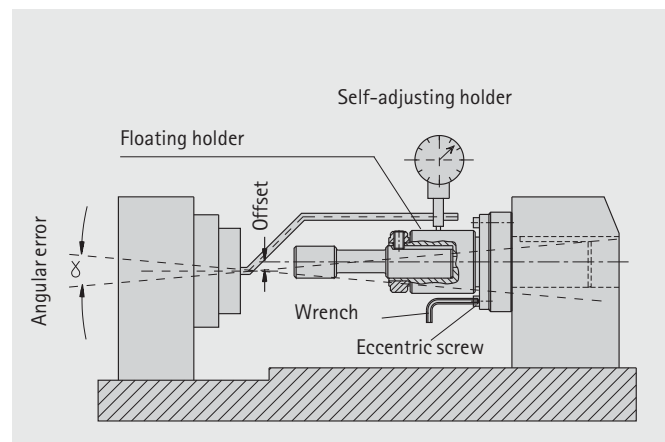
MAPAL floating holder technology**Self-adjusting floating holders**

To obtain even higher machining values and even better results, the floating holder can be combined with the MAPAL self-adjusting floating holder:

The self-adjusting floating holder reduces the necessary floating movement of the floating holder, the radial play is reduced as a result. The performance of the system can be seen at higher spindle speeds and cutting speeds that reach into the HSC area.

1. Layout with self-adjusting floating holder

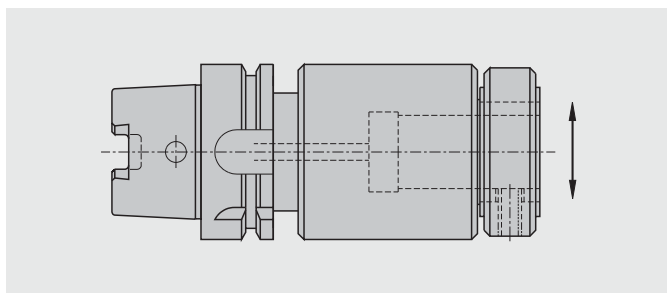
Effect of the radial play on the cutting speed



The floating holder/self-adjusting holder combination also saves long machine downtimes: Instead of aligning the entire machine, the spindle error can be set easily and directly at the self-adjusting floating holder via easy to access eccentric screws.

The new self-adjusting floating holder is suitable especially for usage on lathes (compensation of slide guides) and multiple spindle machines (compensation of tool adapters). In general the MAPAL self-adjusting floating holder can be used wherever manual compensation of an axial error is required.

Clamping systems and clamping technologies

MAPAL floating holders**Simple design, trouble-free function**

The dimensional accuracy and surface finish of a bore can be improved using reamers. For this purpose the reamers are supported on the wall of the bore by their guide elements. This statement applies both to multi-bladed reamers and also to tools based on the single blade principle.

The alignment of the pilot bore with the tool axis is a prerequisite for the correct function of both tool designs. This condition is not satisfied in many cases.

As a result, for instance on machining in multiple clamping systems as well as often on a simple tool change, a cycle and position error occurs and therefore an offset between the tool and workpiece.

The MAPAL "Wellach system" floating holder range was designed for the optimal use of high-speed reamers and compensates for their axial and angular offset.

Advantages:

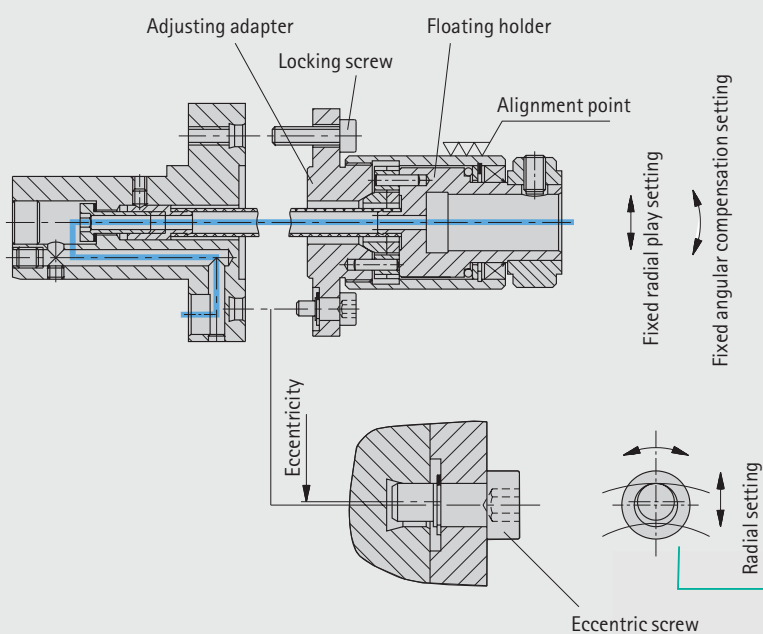
- ▶ Long tool lives, even at high feed rates, due to trouble-free operation
- ▶ Consistent results in series production
- ▶ Reduction of scrap and re-work
- ▶ Small spacing on multiple spindle use due to slender design and small head diameter
- ▶ Advantageous at high spindle speeds
- ▶ No wearing parts, therefore no expensive stock of spare parts

Clamping systems and clamping technologies

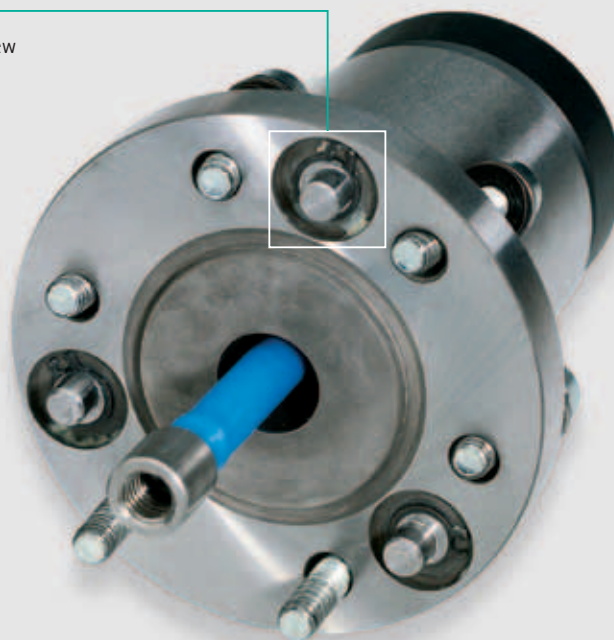
MAPAL floating holder technology

Self-adjusting floating holders

2. Functional principle



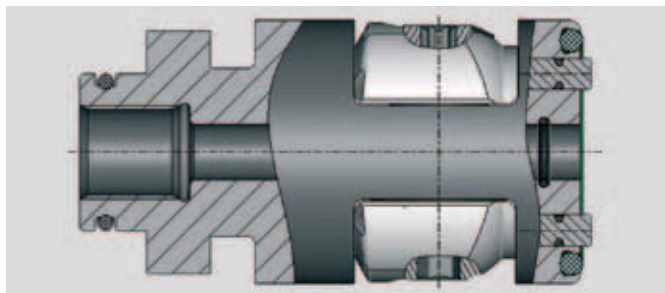
The tool holders are supplied in the 0-position. If the radial play is insufficient, loosen the locking screw and align the floating holder in the machine using the eccentric screws.



MAPAL selection aid

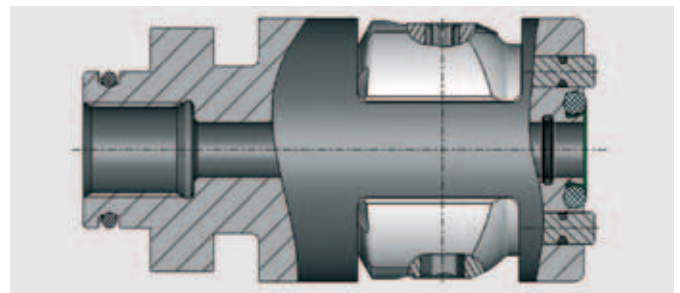
KS clamping cartridge MQL-1 and MQL for MQL applications

Usage of the KS clamping cartridge with outer O-ring MQL-1



KS clamping cartridge MQL1 for MQL applications with outer O-ring.

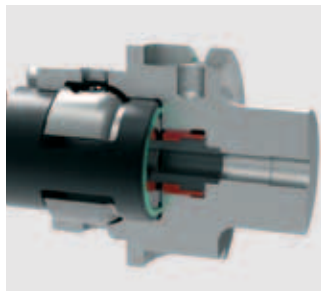
Usage of the KS clamping cartridge with inner O-ring MQL



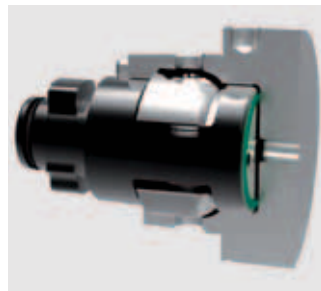
KS clamping cartridge MQL for MQL applications with inner O-ring.

Usage:

For tools with HSK-A or HSK-C shanks on the usage of a filler piece (e.g. MQL shrink chuck).



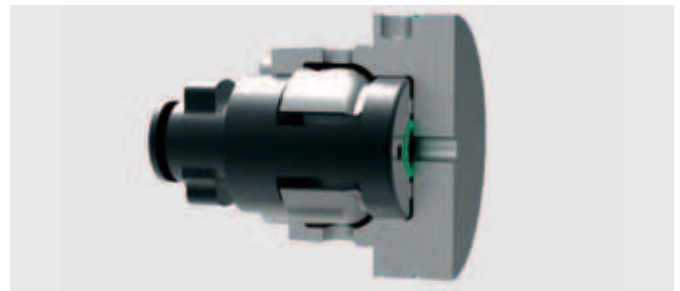
KS clamping cartridge MQL1 with HSK-A shank with filler piece.



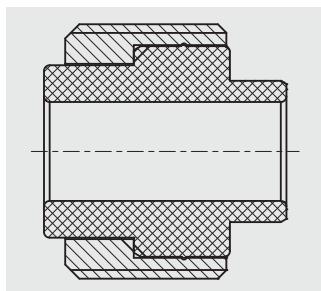
KS clamping cartridge MQL1 with HSK-C shank.

Usage:

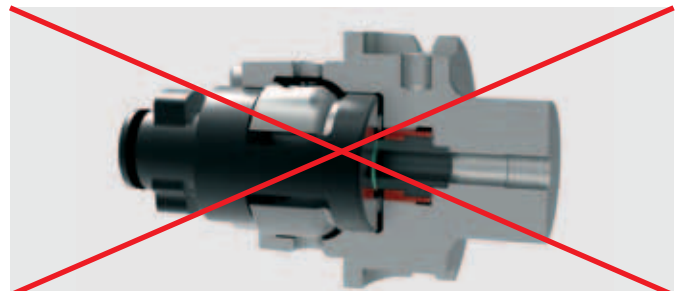
Only for tools with HSK-C shanks.



Attention! Ensure that no tools with HSK-A shanks and a filler piece are used with the clamping cartridge MQL.

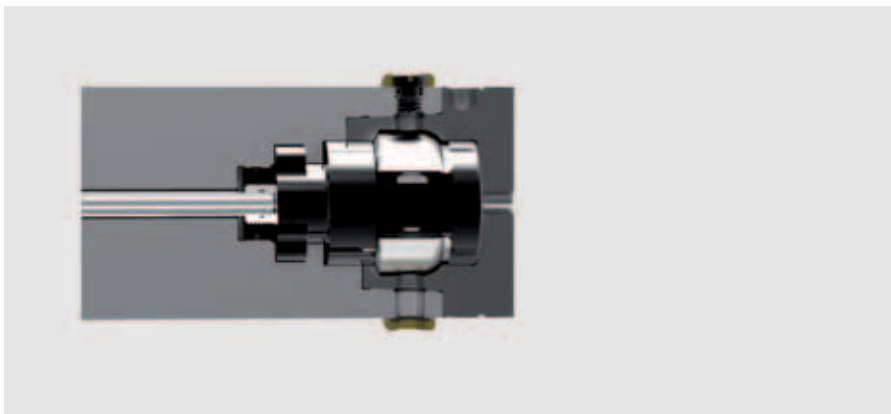


Filler piece (with sealing element)



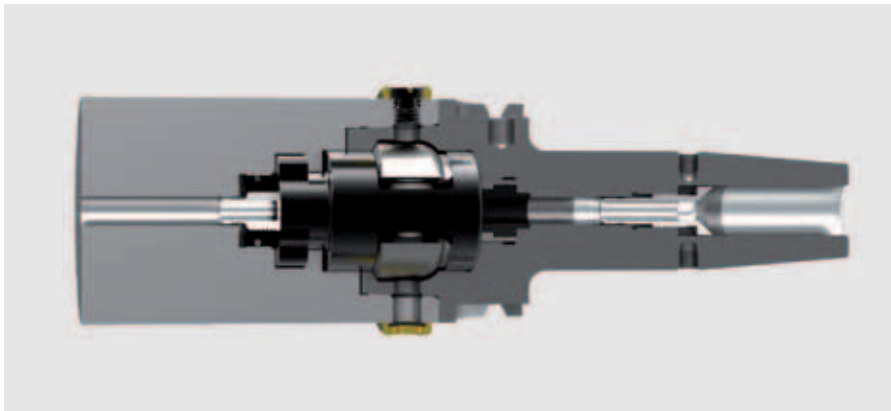
KS clamping cartridge MQL for MQL applications with inner O-ring in use with an HSK-A tool with filler piece.

Machine-side connection options for the KS clamping cartridge for MQL applications



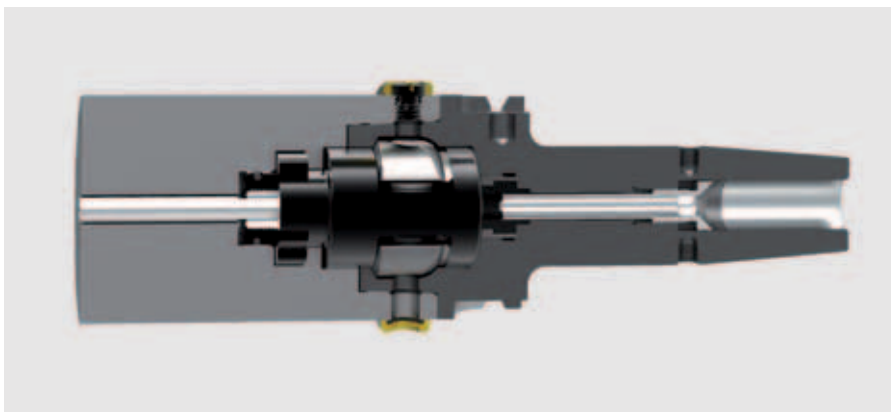
**Adapter tube
with bore transition 1-channel**

Transfer of the aerosol to the clamping cartridge. The spindle-side transfer element protrudes into the clamping cartridge. Sealing is at the bore transition on the adapter tube.



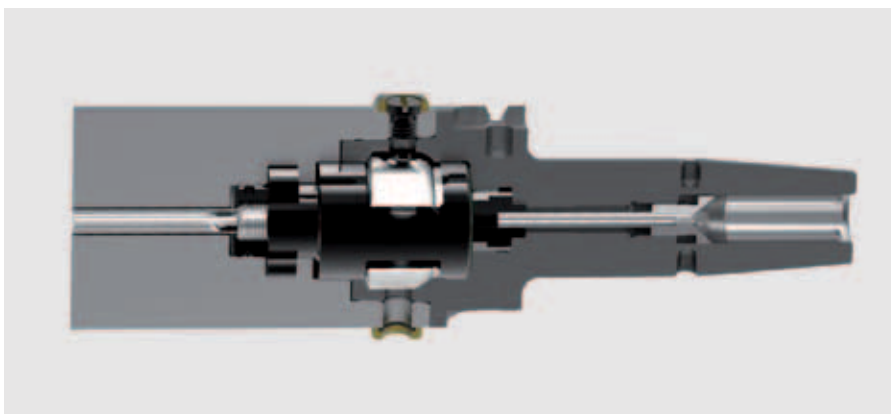
**Adapter tube
with spigot connection**

The aerosol is transferred from the spindle to the clamping tool outside the clamping cartridge. The adapter tube protrudes out of the clamping cartridge and seals the spindle.



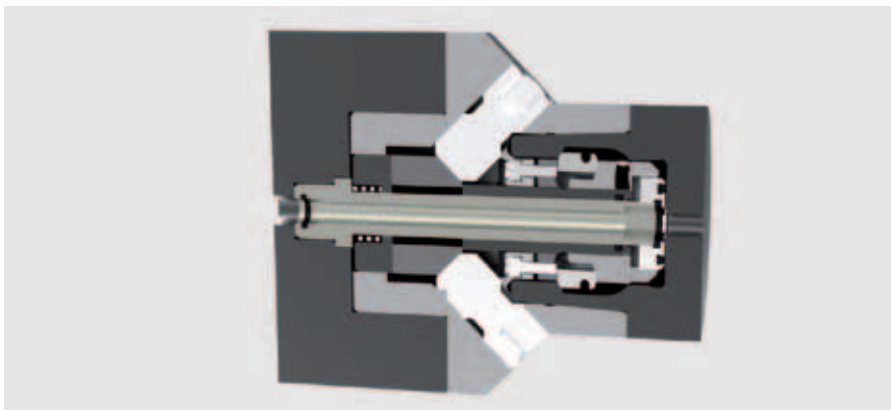
Blanking plug

For usage with KS clamping cartridges for MQL applications, if these are used without an adapter tube. A transfer element transports the aerosol from the mixing system directly to the tool.

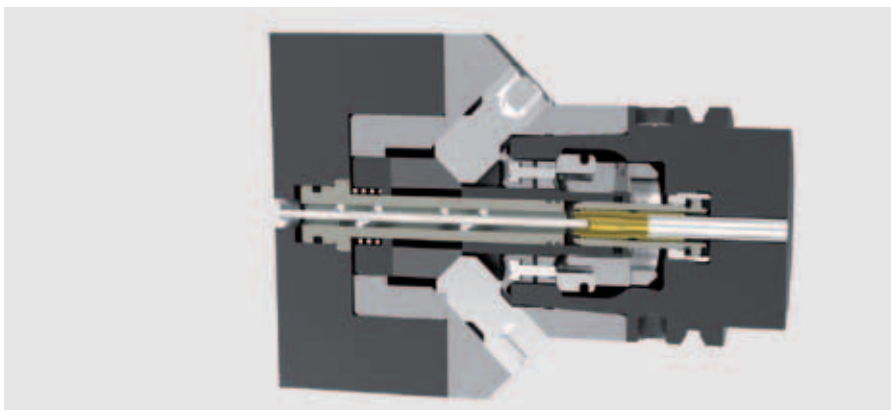


**Adapter tube
with bore transition 2-channel**

MQL clamping cartridge for 2-channel applications. Oil and air can be transported separately to the tool where they are then mixed.



**MQL 1-channel application
with MAPAL DS clamping cartridge
with HSK-C**



**MQL 2-channel application
with MAPAL DS clamping cartridge
with HSK-A**

The lance protrudes into the coolant tube. Optimal transfer of the MQL medium. The same components as for the automatic tool change can be used.

Overview of manual HSK clamping units

Clamping systems	KS clamping cartridge standard		KS clamping cartridge high pressure		KS clamping cartridge MQL1	
						
Type of actuation	3-4 turns with torque wrench		3-4 turns with torque wrench		3-4 turns with torque wrench	
Actuation point (HSK 63)	Radial, 9 mm behind face surface		Radial, 9 mm behind face surface		Radial, 9 mm behind face surface	
Clamping force (HSK 63)	30 kN		30 kN		30 kN	
Actuation torque (HSK 63)	20 Nm		20 Nm		20 Nm	
Central through-bore (HSK 63)	2 x ø 6 mm ICS on HSK-C tools and HSK-A tools without coolant tube		2 x ø 6 mm ICS up to 150 bar on HSK-C tools and HSK-A tools without coolant tube		ø 6 mm central	
Direct mounting in the spindle	Yes		Yes		Yes	
Suitable for HSK designs	HSK-A HSK-B HSK-C	HSK-D HSK-T	HSK-A HSK-B HSK-C	HSK-D HSK-T	HSK-A HSK-B HSK-C	HSK-D HSK-T
HSK sizes	HSK 32 to HSK 100		HSK 32 to HSK 100		HSK 40 to HSK 100	
Application	The proven standard system for almost every application		The solution for high coolant pressures		KS cartridges with central through-bore for MQL applications	

Note: Other HSK sizes available on request.

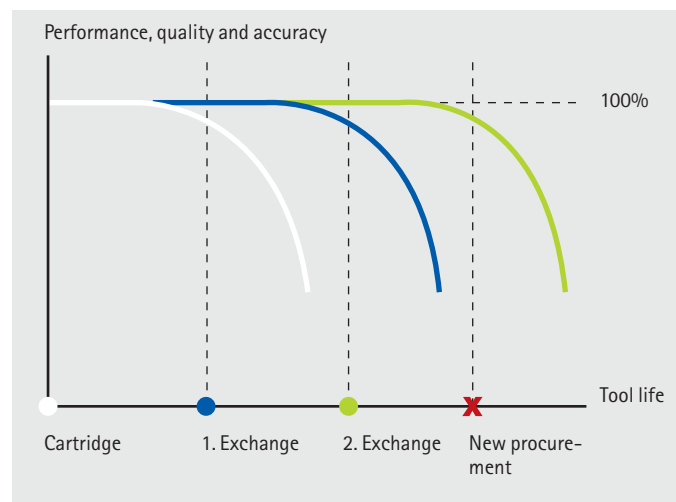
KS clamping cartridge MMS MQL		DS diagonal clamping cartridge		AX axial clamping cartridge	
					
3-4 turns with torque wrench		3-4 turns with torque wrench		360° screw drive with torque wrench	
Radial, 9 mm behind face surface		33 mm behind face surface at 45°		Central from the front or rear	
30 kN		25 kN		25 kN	
20 Nm		approx. 40 Nm		40 Nm	
ø 6 mm central		ø 12 mm central ICS on HSK-C tools and HSK-A tools with or without coolant tube		ø 4 mm ICS on request	
Yes		Yes		Yes	
HSK-A HSK-B HSK-C	HSK-D HSK-T	HSK-A HSK-B HSK-C HSK-D	HSK-E HSK-F HSK-T	HSK-A HSK-B HSK-C HSK-D	HSK-E HSK-F HSK-T
HSK 40 to HSK 100		HSK 32 to HSK 100		HSK 32 to HSK 100	
KS cartridges with central through-bore for MQL applications		The solution with very tight spindle spacings with large central through-bore		Ideal for clamping disc-shaped tools (grinding wheels, saw blades, etc.)	

100% service – the new MAPAL exchange service

Your advantage!

Exchange service – straightforward:

As for all MAPAL products, very high value is also placed on service in the area of manual HSK clamping technology. For this reason MAPAL is offering a new exchange service for the KS clamping cartridges to ensure consistent function and reliability in the process. Compared to a repair by the customer, mistakes during assembly are avoided, the need to stock spare parts and the logistics effort are minimised.

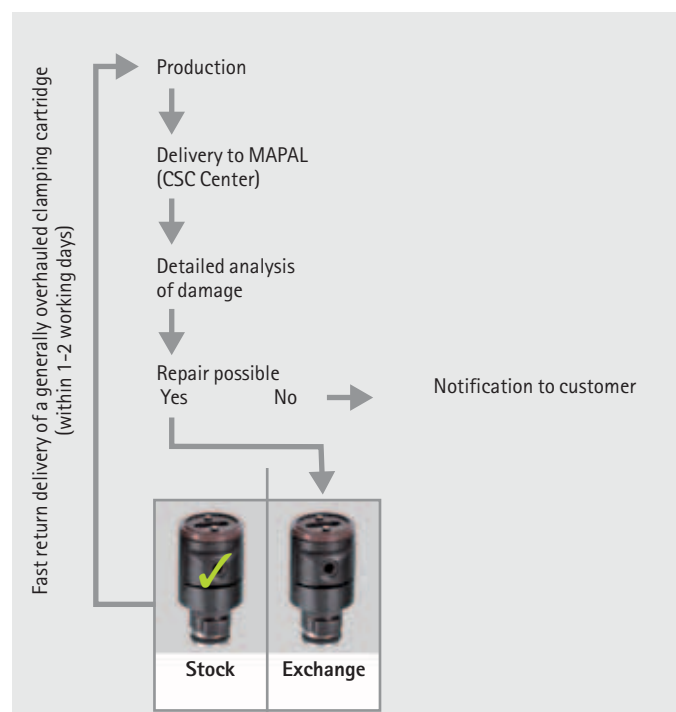


The process!

Reconditioning – possible 2x:

Reconditioned clamping cartridges are treated with the same care as newly manufactured clamping cartridges. All individual parts are checked and wearing parts replaced. After a thorough function check a generally overhauled clamping cartridge is shipped within 1-2 working days.

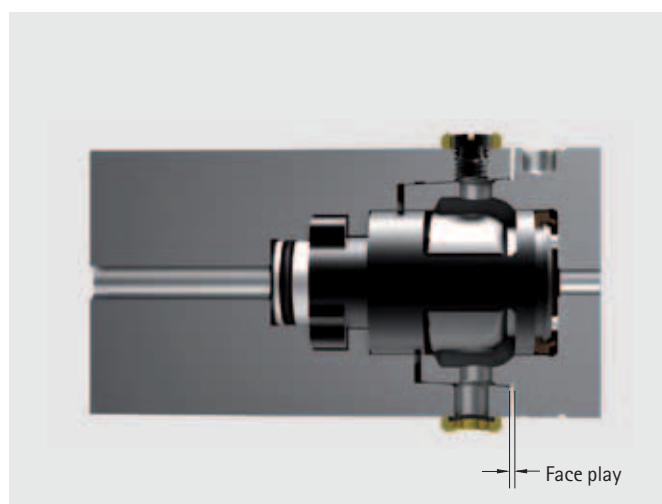
The generally overhauled clamping cartridges are no different to new cartridges in relation to clamping force behaviour, radial run-out accuracy and sealing. They offer 100% performance at an economical price.



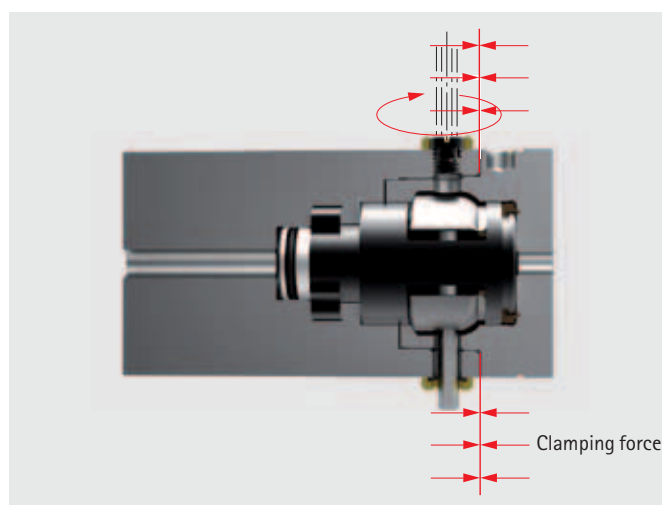
Features of the KS clamping cartridge

Clamping force and bending moment that can be transferred

The pre-loaded HSK connection draws its effectiveness from a high clamping force acting on the face connection with force acting simultaneously on the taper shank. The tolerances on the HSK shank and connection result in oversizes. The predominant portion of the clamping force acts on the face connection and, along with the face connection diameter, is responsible for the absorption of high bending moments.

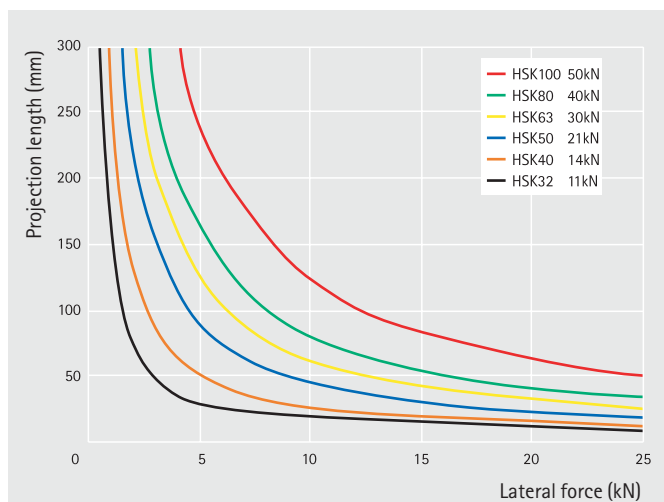


Unclamped face connection-taper joint



Clamped face connection-taper joint

Features of the KS clamping cartridge

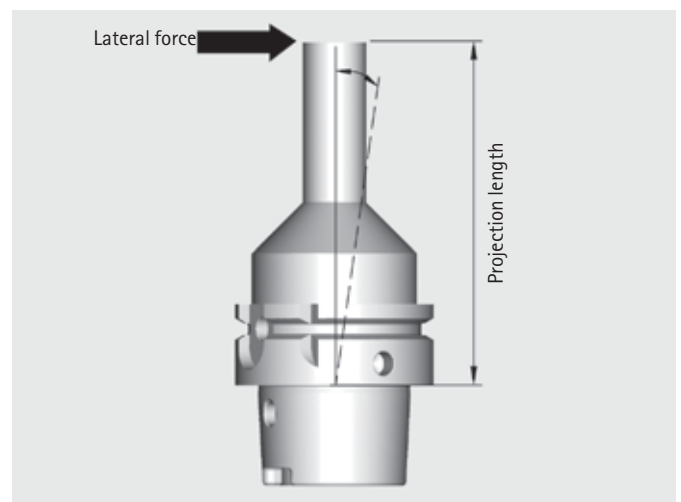


Permissible bending load on the HSK connection on the use of the KS cartridge

The MAPAL KS clamping permits higher clamping forces than recommended in accordance with DIN due to the particularly compact design of the clamping mechanism. As a result an extremely high bending moment load can be applied and the connection has high rigidity.

In practical use this means:

Absorption of high machining forces even at high projection lengths as well as improved tool lives and



therefore maximum productivity. Depending on the external load, the lower DIN clamping forces may also be sufficient.

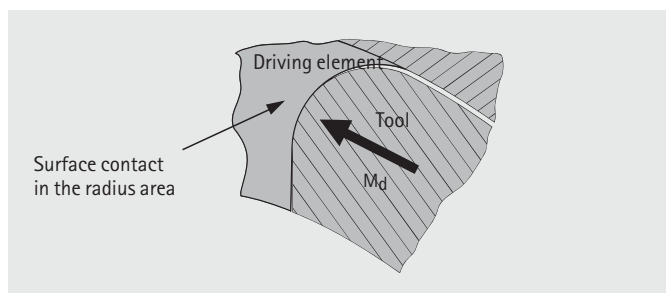
The values given in the table are the result of extensive tests in research and practice and represent an orientation aid for the user. Depending on the specific case, even higher loads may be possible.

Nominal size HSK		32	40	50	63	80	100
Shank diameter d_1	mm	24	30	38	48	60	75
Clamping force (DIN 69893)	kN	4,5	6,8	11	18	29	45
Clamping force (MAPAL KS)	kN	11	14	21	30	40	50
Clamping moment	Nm	6	7	15	20	30	50
Lifting moment $M_{Lifting}$	Nm	150	260	460	625	1.005	1.400

Clamping force and lifting moment

Transferable torque

HSK connections transmit both force closure and form closure torques. The high clamping force of the MAPAL KS clamping results in high friction forces on the taper and face connection, and therefore in correspondingly high friction moments ($M_{d, \text{friction}}$).



The form closure torque transmission features compact driving elements in the connections; the radii on these driving elements mesh exactly and therefore permit the highest transferable values.

On tools made of 16MnCr5 / 1.7131, the form closure torque transmission on its own permits a very high maximum permissible torque ($M_{d, \text{max}}$). On the use of high quality materials, for instance 1.6582 or 1.2343, these values increase drastically.

Ideal torque transmission with meshing in the radius area

Radial run-out and accuracy of repetition

The accuracy of the HSK connection is the outstanding feature of this standardised connection system. In conjunction with the non-coercive KS clamping, changeover accuracies and accuracies of repetition

in the micron range are possible that open up new perspectives for improving quality.

The accuracy of repetition of the HSK connection is $< 1 \mu\text{m}$ axially and $< 3 \mu\text{m}$ radially.

Nominal size HSK		32	40	50	63	80	100
Clamping force	kN	11	14	21	30	40	50
Torque $M_{d, \text{friction}}$	Nm	35	57	115	250	450	900
Torque $M_{d, \text{max}}$	Nm	275	500	900	1.600	3.300	6.000

Transferable torques

Spindle speed limits

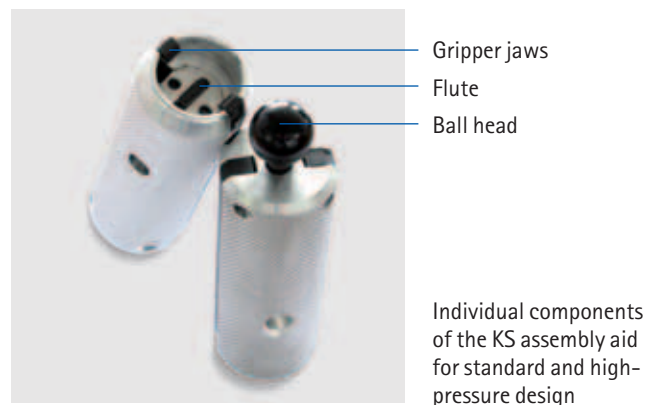
The spindle speed limit for the HSK connection is defined by numerous factors. The length of the location taper, the oversize between taper shank and taper holder and also the clamping system used have a major effect. For applications at high spindle speeds, it is therefore necessary to determine the spindle speed limit on a case-by-case basis. The figures on the right can be used as rough estimates.

Nominal size HSK	Spindle speed limit $[\text{min}^{-1}]$
32	50.000
40	42.000
50	30.000
63	24.000
80	20.000
100	16.000

Estimated spindle speed limits for HSK connections

Installation of the KS clamping cartridge in machine spindle, chuck or adapter using assembly aid

Designation of the individual components of the KS assembly aid



Notes:

For the KS clamping cartridge in standard and high-pressure design, only use the KS assembly aid for standard and high-pressure designs with the flute.

For the MQL design KS clamping cartridges only use the KS assembly aid for the MQL design with the two pins.



Opening the KS assembly aid

1. Open the KS assembly aid gripper jaws by pushing down the ball head.
2. Keep the ball head pressed down.

Notes:

Make sure the KS assembly aid gripper jaws are open and that the flute of the KS clamping cartridge fits into the sheath in the standard and high pressure designs.

3. Insert the KS clamping cartridge into the KS assembly aid.
4. Release the ball head.

Result:

The KS clamping cartridge is connected to the KS assembly aid.



Inserting the KS clamping cartridge into the KS assembly aid.



Inserting the KS clamping cartridge

Note:

Make sure that the corresponding contours of the clamping cartridge and the machine spindle or the adapter match each other. The KS clamping cartridge can only be inserted into the machine spindle or into the adapter in one position.

5. Insert the KS clamping cartridge into the machine spindle or the adapter in the correct position.
6. Rotate the KS assembly pliers counter-clockwise until the plug of the KS clamping cartridge audibly and noticeably snaps in.
7. Press the ball head of the KS assembly pliers down to pull the KS assembly pliers back off.



Arresting the KS clamping cartridge

Installation of the KS clamping cartridge in machine spindle, chuck or adapter using assembly tool

Using assembly tool



1. Insert clamping cartridge in the spindle or in the adapter.



2. Fit socket to the clamping cartridge.



3. Turn clockwise until the lug on the clamping cartridge engages with the clamping pin.

Clamping the tool

Nominal size	HSK 32	HSK 40	HSK 50	HSK 63	HSK 80	HSK 100
Tightening torque [Nm]	6	7	15	20	30	50
Clamping force [kN]	11	14	21	30	40	50

Tightening torque and clamping force for the individual nominal sizes of the KS clamping cartridge, standard design.

Nominal size	HSK 32	HSK 40	HSK 50	HSK 63	HSK 80	HSK 100
Tightening torque [Nm]	6	7	15	20	30	50
Clamping force [kN]	11	14	21	30	40	50

Tightening torque and clamping force for the individual nominal sizes of the KS clamping cartridge, high-pressure design

Nominal size	HSK 32	HSK 40	HSK 50	HSK 63	HSK 80	HSK 100
Tightening torque [Nm]	n.a.	6	15	20	30	50
Clamping force [kN]	n.a.	11	21	30	40	50

Tightening torque and clamping force for the individual nominal sizes of the KS clamping cartridge, MQL design

Notes on the use of the KS clamping system

On the operation of spindles or adapters that are equipped with a clamping cartridge and that are operated without a tool, a cap should always be used. In this way the system and user are protected, soiling is prevented.

In case of tool usage with low radial loads, e.g. drilling and reaming operations, it is allowed to drop approx. 25 % below the maximum tightening torque.

Maintenance and care

During each tool change the taper should be cleaned with a taper wiper.

The clamping cartridge should be regreased after extended use. This interval depends on the frequency of tool changing, the type of machining and the coolant. However, regreasing should be undertaken one every six months as a minimum.

Setting and handling notes

KS flange adapter**1. Assembling and aligning the KS flange adapter with radial alignment**

1. Clean taper and face surfaces on the flange adapter and adapter.



2. Insert flange adapter. Tighten fastening screws to 50 % of the tightening torque stated (see table page 284).



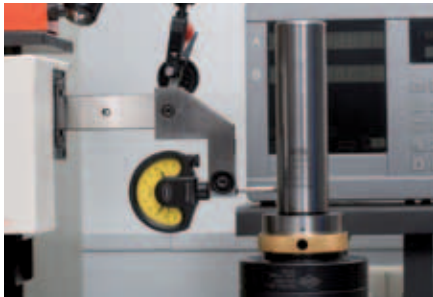
3. Clean taper and face surface on test arbor or tool.



4. Insert test arbor or tool and fasten using clamping screw.

Setting and handling notes

KS flange adapter



5. Place dial gauge in contact at the position for the radial run-out check. On MAPAL tools it is also possible to use the HSK collar for alignment. Take highest measured point and set dial gauge to "zero".



6. Roughly align flange adapter (approx. 0.01 mm). Relieve adjusting screws again after each actuation.



7. Set radial run-out using adjusting screws. Again relieve the adjusting screws after each actuation. Repeat process until radial run-out is $< 3 \mu\text{m}$.

8. Tighten fastening screws diagonally and bring up to tightening torque (see table). After reaching the full tightening torque, check radial alignment again and correct if necessary. Place adjusting screws in light contact.



The radial alignment can also be undertaken using measuring sensors. For this purpose the feeler is placed in contact with the taper on the flange adapter.

Tightening torques

Nominal size	Module diameter	Fastening screw	Tightening torque
HSK 32	60	DIN 912 – M5x16 – 12.9	8.7 Nm
HSK 40	70	DIN 912 – M6x20 – 12.9	15 Nm
HSK 50	80	DIN 912 – M6x20 – 12.9	15 Nm
HSK 63	100	DIN 912 – M8x25 – 12.9	36 Nm
HSK 80	117	DIN 912 – M8x25 – 12.9	36 Nm
HSK 100	140	DIN 912 – M10x30 – 12.9	72 Nm

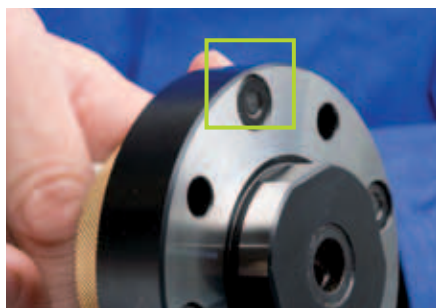
The basis for the maximum tightening torque of the cylinder head screws in accordance with DIN 912 is the general DIN standard for property class 10.9.

MAPAL only uses cylinder head screws in accordance with DIN 912 with the property class 12.9.

Setting and handling notes

KS flange adapter

2. Assembling and aligning KS flange adapters and MAPAL Module adapters with radial and angular alignment



1. Clean face surfaces on flange adapter and adapter (see page 283). Ensure that the face surface on the alignment screw does not protrude beyond the face surface in the flange adapter.



2. Insert flange adapter. Place fastening screws in contact.



3. Clean taper and face surface on the test arbor very carefully. Insert test arbor or tool.



4. Place dial gauge in contact at the position for the radial run-out check. On MAPAL tools it is also possible to use the HSK collar for alignment. Take lowest measured point and set dial gauge to "zero". Align radially. For procedure see page 284.



5. For the angular alignment, the dial gauge is positioned at the upper point to be checked or approx. 100 mm from the connection. Align angularly using alignment screws. Do not relieve the alignment screws after actuation.

6. Once the angular alignment is set to $< 3 \mu\text{m}$, check again radial alignment at the position for the radial run-out check on the collar and correct if necessary. Should it be necessary to correct the radial alignment, then check the angular alignment again afterwards.

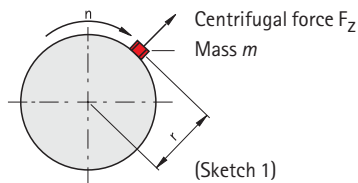
Definition, calculation, effect and limits of balancing

1. Imbalance and imbalance calculation

The imbalance U is a measure that states how much mass m there is at a specific radius r in relation to the axis of rotation (see Sketch 1). It has the "unwieldy" unit gmm and is calculated using Formula A:

$$U = m \cdot r$$

(Formula A)

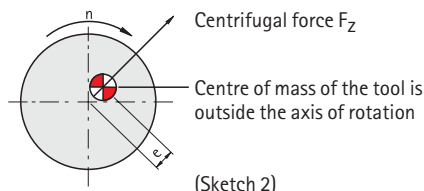


(Sketch 1)

With a rotating machining tools the imbalance is in general referred to the mass of the tool m_{TL} and calculated using the eccentric offset e of its centre of mass in relation to the axis of rotation:

$$U = m_{TL} \cdot e$$

(Formula B)



(Sketch 2)

The imbalance is determined on a balancing machine and the mass to be compensated automatically converted, as per Formula A, to the radius r at which the material compensation is made in such a way that the tool satisfies the customer requirements.

The permissible distance e_{perm} is given by the balancing quality G and the required spindle speed n in accordance with Formula C:

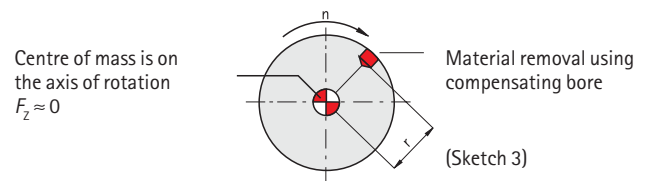
$$e_{perm} = G \frac{60}{2 \cdot \pi \cdot n} \quad (\text{Formula C})$$

and is a good measure for estimating how difficult the balancing will be and whether a balancing requirement can be realised.

The correspondingly permissible residual imbalance mass m_R is given by

$$m_R = m_{TL} \cdot \frac{e_{perm}}{r} \quad (\text{Formula D})$$

For example, in accordance with Formula C for a tool adapter with a required balancing quality of G 6.3 and a spindle speed n of $10,000 \text{ min}^{-1}$ the permissible distance $e_{perm} = 6 \text{ }\mu\text{m}$. For a compensation radius $r = 16 \text{ mm}$ and a tool mass of $m_{TL} = 1 \text{ kg}$ from Formula D the permissible residual imbalance m_R is then 380 mg.



On a rotating spindle the imbalance generates a centrifugal force F_z , that, if the imbalance is too great, can have a negative effect on the machining process and/or the service life of the spindle bearings. The centrifugal force F_z increases linearly with the imbalance and with the square of the spindle speed n as per formula E:

$$F_z = U \cdot \omega^2 = U \cdot (2 \cdot \pi \cdot n)^2 \quad (\text{Formula E})$$

To avoid these centrifugal forces, in general compensating bores and surfaces are applied to tool adapters and tools, as a result the centre of mass is moved back in the direction of the axis of rotation and the centrifugal force is reduced correspondingly (see Sketch 3).

The balancing quality G is calculated using:

$$G = e \cdot \omega = \frac{U}{m} \cdot \frac{2 \cdot \pi \cdot n}{60} \quad (\text{Formula F})$$

Definition, calculation, effect and limits of balancing

2. Balancing limits

The objective of balancing a tool adapter (with tool) must be to ensure adequate balancing quality for the specific application.

This activity therefore always represents a compromise between the technically feasible and the technically and commercially appropriate.

In general it can be stated that a balancing requirement is both unrealistic and unrealisable if the resulting permissible dimension e_{perm} is less than the radial clamping accuracy(ies) of the tool adapter used.

For the hollow taper shank (HSK) as the most accurate connection at the moment, this limit is at $e_{min} > 2 \mu m$.

With this value there is in accordance with Formula B for a tool adapter with a clamped tool (total mass 1.340 g) a possible imbalance that cannot be changed of 2.68 gmm or as per Formula F at a spindle speed of e.g. 30,000 min^{-1} a best possible balancing quality of G 6.3.

The same clamping (in)accuracies as on use in the machine tool spindle are, of course, also present beforehand

on the balancing machine, such that for this reason a lower residual imbalance or a better balancing quality cannot be achieved reproducibly.

Also the measuring accuracy of balancing machines, as are in use in the tool industry, must be taken into account in this overall assessment.

At a display sensitivity of 0.5 gmm on a high quality balancing machine this means a further measurement uncertainty in relation to the centre of mass offset of 0.5 μm or in relation to the balancing quality ΔG 1 at 30,000 min^{-1} (tool mass 1.340 g).

Definition, calculation, effect and limits of balancing

3. Balancing chucks for cylindrical shanks Form HB and HE

Standard tools such as drills and milling cutters are used in these chucks; due to their clamping surface(s) these tools have an imbalance related to their design. If the adapters for these tools are now balanced without taking into account this imbalance, the entire imbalance on the tool inserted is transferred to the "adapter + tool" package assembled.

For this reason, to correctly balance the adapter either a shank must be clamped in the adapter or the corresponding imbalance must be "contained" on the screw side. Here the material from which the tool to be clamped is made (essentially HSS or carbide) is of major significance due to the varying specific density.

If the tool material is either unknown or it varies, these adapters can be balanced for a "fictional material" that with a theoretical density of 11.2 g/mm^3 is exactly in the middle between that density of steel (7.8 g/mm^3) and carbide (14.6 g/mm^3). As a consequence the possible error in the case of the user's general need to have a free choice of tool material is only half as great as if balancing were to be undertaken for steel or carbide.

In relation to the generally realisable balancing limits for such adapters, it is also necessary to take into account the accuracy of the clamping of the cylindrical shank in the location bore.

Example:

Tool $\varnothing 25 \text{ mm}$ / 370 g

DIN tolerances: Bore H5 give \varnothing tolerance
 $0/+9 \text{ }\mu\text{m}$
 Shank h6 gives \varnothing tolerance
 $0/-13 \text{ }\mu\text{m}$
 maximum radial offset $11 \text{ }\mu\text{m}$

For the overall tool considered (adapter + tool = 1.340 g) as per Formula F for a machining spindle speed of $8,000 \text{ min}^{-1}$ there is a possible degradation in the balancing quality of $\Delta G 2.5$. The clamping accuracy of the HSK results in a further uncertainty of $\Delta G 1.68$.

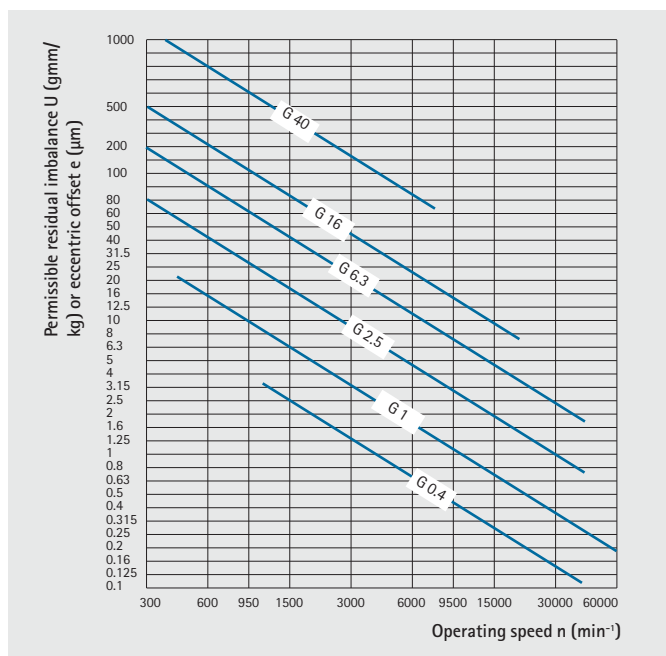
The conclusion in the case of these adapters can only be that requirements below G 6.3 are hardly appropriate. In certain cases it can be necessary to balance tool adapter and tool together. However, clear limits can only be defined taking into account the tool type, projection length and machine or spindle design.

The following diagram (in accordance with DIN/ISO 1940-1) shows for the balancing quality steps G the permissible standardised residual imbalance U on a balancing body mass of 1 kg and the permissible centre of mass offset e as a function of the operating speed n .

Definition, calculation, effect and limits of balancing

4. Formula symbols, units and formulae

5. Fine balancing



MAPAL clamping tools are balanced as standard to G 2.5 at 16,000 min⁻¹. If needed, other balancing qualities can be requested.

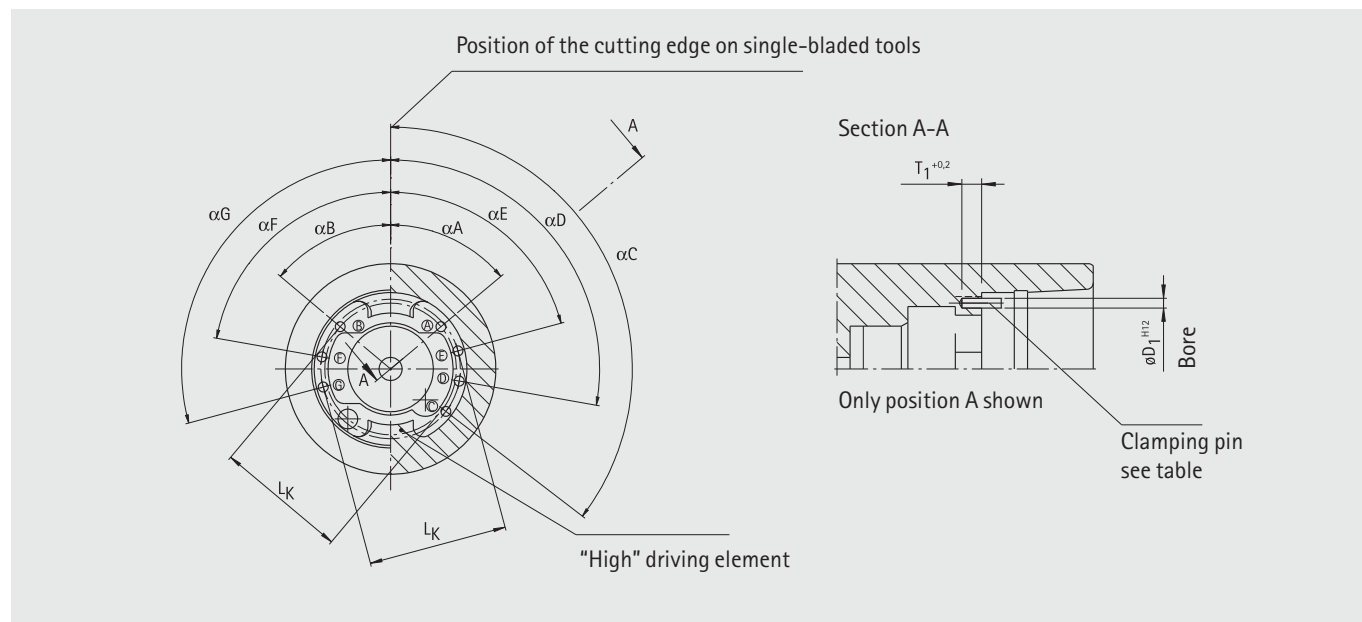
Formula symbol	Units	Formulae	Term
e	μm	$e = \frac{U}{m_{tl}}$	eccentric offset
e_{perm}	μm	$e_{perm} = G \cdot \frac{60}{2 \cdot \pi \cdot v}$	permissible distance
F_z	N	$F_z = U \cdot \omega^2$	Centrifugal force
G	mm/s	$G = e \cdot \omega$	Balancing quality
m	g		Mass
m_R	g	$m_R = m_{tl} \cdot \frac{e_{perm}}{r}$	Permissible residual imbalance mass
m_{tl}	g		Mass of the tool
n	min ⁻¹		Spindle speed
r	mm		Radius
U	gmm	$U = m \cdot r = m_{tl} \cdot e$	Imbalance

Coding system for hollow taper shanks

Multiple spindle drill heads are very often used in custom machines. In this case a very large number of spindles are arranged in a small space. So that operating errors can be excluded during the tool change, DIN 69894 "Safety

device for correct positioning for hollow taper shanks" was prepared. With this system additional pins in the tool spindles and slots on the end of the HSK shank ensure unambiguous allocation of a tool to a specific spindle.

Coding system for tool spindles:

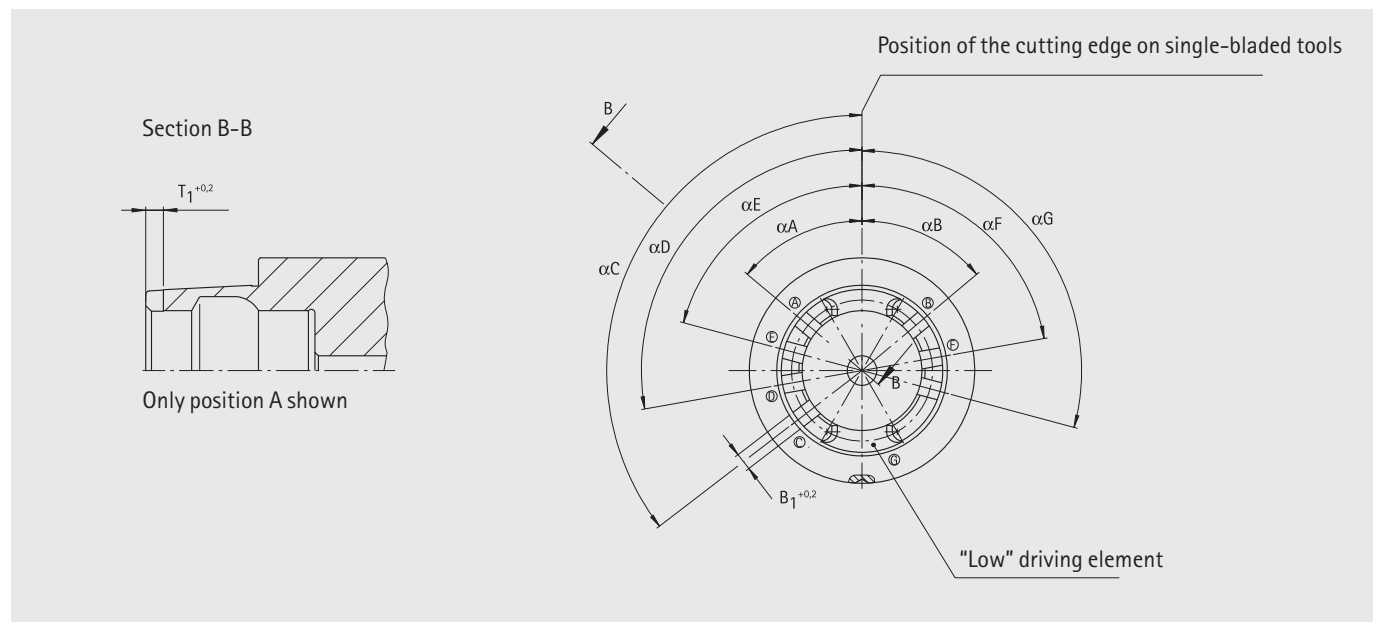


Position HSK	(A) α A	(B) α B	(C) α C	(D) α D	(E) α E	(F) α F	(G) α G	D_1	T_1	L_K	Clamping pin
32	50°	50°	127,5°	100°	75°	80°	105°	1,5	3	At the discretion of the manufacturer	DIN 1481-1,5x6
40	52,5°	52,5°	127,5°	100°	75°	80°	105°	2	3		DIN 1481-2x6
50	55°	55°	125°	100°	75°	80°	105°	2,5	3		DIN 1481-2,5x6
63	60°	60°	120°	105°	75°	75°	105°	3,5	4		DIN 1481-3,5x8
80	60°	60°	120°	105°	75°	75°	105°	4,5	5		DIN 1481-4,5x10
100	45°	45°	135°	105°	75°	75°	105°	4,5	7		DIN 1481-4,5x12
125	45°	45°	135°	105°	75°	75°	105°	4,5	7		DIN 1481-4,5x12
160	45°	45°	135°	105°	75°	75°	105°	4,5	7		DIN 1481-4,5x12

☐ = use as a matter of preference!

Coding system for hollow taper shanks

Coding system for tool shanks:



Position HSK	(A) αA	(B) αB	(C) αC	(D) αD	(E) αE	(F) αF	(G) αG	D_1	T_1
32	50°	50°	127,5°	100°	75°	80°	105°	2,5	2,5
40	52,5°	52,5°	127,5°	100°	75°	80°	105°	3	2,5
50	55°	55°	125°	100°	75°	80°	105°	3,5	2,5
63	60°	60°	120°	105°	75°	75°	105°	4,5	3,5
80	60°	60°	120°	105°	75°	75°	105°	5,5	4,5
100	45°	45°	135°	105°	75°	75°	105°	5,5	5
125	45°	45°	135°	105°	75°	75°	105°	5,5	5
160	45°	45°	135°	105°	75°	75°	105°	5,5	5

☐ = use as a matter of preference!