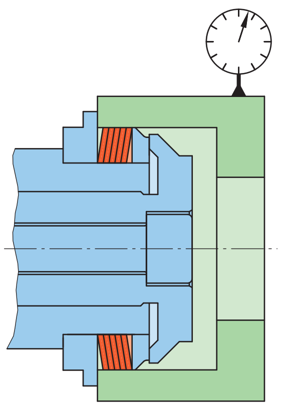
Advantages of RINGSPANN Clamping Fixtures

RINGSPANN®

High true running accuracy

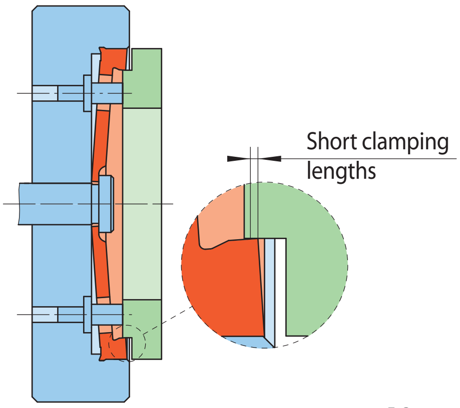
True running accuracy of ≤ 0,01 mm is attainable.



5-1

Short clamping lengths

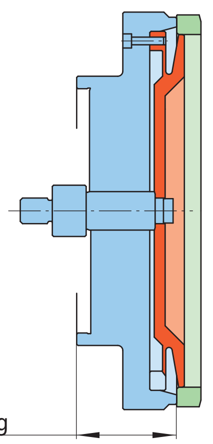
The RINGSPANN system permits short clamping lengths with high torque transmission.



5-2

Short clamping fixture length

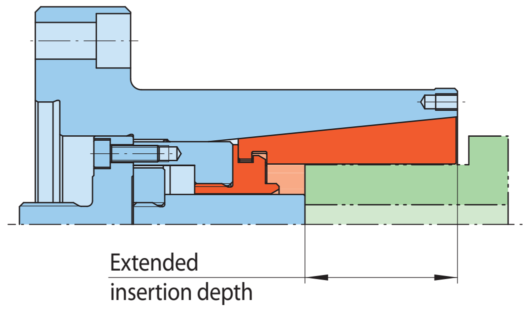
Clamping Fixtures based on the RINGSPANN system ensure minimum spindle overhang and thus high spindle rigidity and precision.



5-3

Extended insertion depths

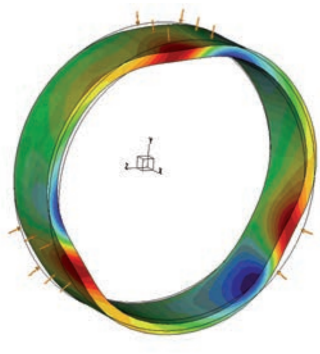
The RINGSPANN system supports extended insertion depths with high torque transmission.



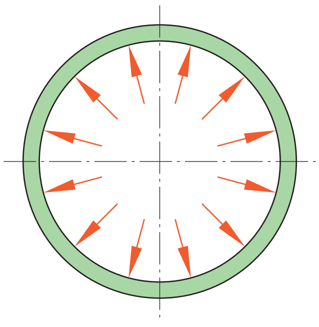
5-4

No deformation

The thinner-walled a workpiece is, the more sensitive to deformation it becomes. A three-jaw chuck can no longer be used economically with such workpieces, since the clamping forces must be reduced to a level that ensures it doesn't cause any impermissible deformation. This inevitably leads to a reduction of the cutting data and thus an increase in the impact duration. Using RINGSPANN Clamping Fixtures, workpieces are gripped over their entire circumference. It is thus possible to clamp with much higher forces, which ensures that the economic efficiency of production is maintained thanks to high cutting performances and short impact duration.



5-5



5-6

Key: Clamping fixture · Clamping Element · Component

Technical points

for Clamping Elements

RINGSPANN®

General information

The deployment and ambient conditions for RINGSPANN Clamping Fixtures and Clamping Elements are different for every application. The workpiece itself, with its geometry, hardness, surface quality and the type of the assembly, exert influence on the Clamping Fixture. That is why RINGSPANN cannot provide any information on the wear behaviour and, as a result, cannot provide any prediction on the expected service life of the Clamping Fixture and instead only give general maintenance information.

Maintenance and cleaning of the Clamping Fixture should be carried out at the latest when the maintenance of the machine is carried out. More frequent maintenance intervals may become necessary through observation during operation and regular visual inspection e.g. at shift commencement.

Prerequisites for the component to be clamped for the use of RINGSPANN Clamping Fixtures

RINGSPANN Clamping Fixtures require a pre-machined diameter and a pre-machined contact surface. It is hereby assumed that the contact surface and clamping diameter run impact-free to one another and the diameter to be clamped doesn't have any concentricity errors.

Installation and commissioning

- Clamping Discs, Bonded Disc Packs, Disc Elements, Taper Collets, Taper Sleeves, Flat Elements, Basket Elements or Short Elements are coated with a light coat of oil and pressed onto the seating diameter.
- In the case of Basket Elements, Short Elements and Flat Elements, the Clamping Element must first be pressed with a portion of its circumference into the seating diameter. It is then gradually driven along its entire circumference into the seating diameter by applying careful, inward blows with a rubber hammer.

When installing RINGSPANN Clamping Elements, it is important to ensure that they contact firmly against the entire circumference of the axial backstop.

Maximun true running accuracy is achieved by clamping and releasing the fixture once without a component and then three times with a component after installation and before component processing begins.

No shifting of position on the seating diameter

The Clamping Fixtures must be designed in such a way as to ensure that the Clamping Elements cannot shift position on the seating diameter either during clamping or during release.

Axial component pull-back

Axial pull-back is required for processing a component in accordance with the true running accuracy specifications set by RINGSPANN. It is important to ensure that the contact surface moves without impact to the the clamping diameter and the component contact to the surface with the maximum possible diameter. In order to prevent soiling, the backstop ring surfaces should be as narrow as possible or unslotted. If backstop pins are used, they must be ground without axial and radial runout.

In the event that "runout" cannot be restricted through constructive measures, clamping must be effected at two centring points positioned as far apart as possible. We recommend using a cardanic ring (pendle ring) as a backstop. Maximum possible true run accuracy of Clamping Fixtures cannot be achieved with ball discs and bevel socket washers in accordance with DIN 6319 as moving backstops.

Maximum permissible speeds

RINGSPANN Clamping Fixtures, except for Basket Element Clamping Chucks (1 000 rpm), are suitable for tool machines with a speed of up to 3 500 rpm. If a higher speed is envisaged, please contact us.

Sealing, chip removal

Rubberized RINGSPANN Clamping Elements (except for Taper Collets) are protected against the ingress of chips and dirt. In the case of vertically positioned chucks, cavities and bores for complete chip removal must be provided.

Technical points

for Clamping Elements

Verification of selected Clamping Elements

Transmissible torque, required actuating force, specific pressure

The required actuating forces for the selected Clamping Elements are calculated in this section. Actuating forces F, F_o or F_m and F_{on} or F_{mn} for transmission of the maximum possible torques M, M_1 and M_n are shown in the table. These maximum forces may not be exceeded.

The following apply to Clamping Discs:

$$M = n \cdot M_1 \quad [Nm]$$

$$F_o = n \cdot F_{o1} \quad [N]$$

$$F_m = n \cdot F_{m1} \quad [N]$$

n = number Clamping Discs (max. 16)

If the actuating forces are lower than the maximum forces, transmissible torque M is reduced and the specific pressure between the Clamping Element and the component is reduced proportionally (down to half of catalogue values). This may be necessary in cases involving

- thin-walled components,
- soft materials,
- sensitive components surfaces and
- slotted component clamping surfaces.

Axial holding force

The axial holding force F_{ax} is derived from the catalogue values of "transmissible torque M" and "clamping diameter D".

$$F_{ax}\,[N] = \frac{M\,[Nm] \cdot 1\,000\,[^{mm}/_{m}]}{^{D}/_{2}\,[mm]}$$

Clamping accuracy

If all functional surfaces of a Clamping Fixture are free of radial and axial rounout, the achievable true run accuracy is:

- up to clamping diameter of 300 mm: 0,01 mm (0,005 mm centre misalignment),
- over a clamping diameter of 300 mm: 0,02 mm (0,01 mm centre misalignment).

If greater accuracy is required, all Clamping Fixture components (and possibly the Clamping Element) must be prevented from twisting. The following procedure must be employed:

1. Alignment of the Clamping Fixture on the machine spindle with the aid of a master component. Radially adjustable setting screws should be provided as alignment aids.
2. In the case of fixtures with rigid centring, both the slightly pre-loaded Clamping Elements and the axial contact surfaces must be lightly ground to the exact clamping diameter.

Dimension control

Due to their elasticity, dimension control of RINGSPANN Clamping Elements that have not been installed is not possible. Dimension control cannot be performed until the Clamping Fixture has been assembled, as the Clamping Elements are pre-loaded.

Rubber coating

The Bonded Disc Packs LAF, LHF, LBD and LID, as well as all standard Clamping Elements HKF, HKD, KFF, KFD and HDDS, are generally rubber-coated. All other Clamping Elements can be rubber-coated in the slots according to the customer's wishes (exception BKF). Exempted from a rubber coating are through-holes for backstop pins.

The rubber is elastic; however, it takes on the new form with the increasing duration of a deformation during clamping (clamping relaxation). This can lead to the Clamping Element not immediately fully returning to its original position when opening the Clamping Element. The clearance for insertion is then reduced and the removal of the workpiece or the assembly with a new workpiece is potentially made more difficult.

Life (service life) of Clamping Elements

The service life of RINGSPANN Clamping Elements is limited by the nature of its use. The Clamping Element can only hold 500 parts or still work without issue after three million workpieces. This depends on the wear, ultimately on the workpiece to be clamped, its hardness, surface quality, the automation components and the processing. In principle, the workpiece slowly abrades the clamping surfaces of the Clamping Elements. Ultimately, the wear degree can only be examined by the machine operator via a regular inspection of the diameters at the Clamping Element in relaxed and fully clamped state.

Multiple clamping points

Engineering design and the calculation of forces and torques for Clamping Fixtures with two or more clamping points are very complex. We recommend having such Clamping Fixtures produced entirely by RINGSPANN. Please send us the completed questionnaire on page 78.

Technical points

RINGSPANN®

for Clamping Elements
for Spring Force Actuator

Material and hardness

Clamping Fixtures are made of case-hardened steel for maximum effectiveness. Components which come in contact with Clamping Elements are inserted and hardened:

- Hardness rating HRc 62 ± 2
- Hardening depth after grinding 0,5 mm

Required transmissible machining torques

The actual machining torques to be transmitted must be specified by the customer.

In balancing operations, the mass moment of inertia during accelerating/braking (emergency cutoff) is the crucial factor.

Clearance for insertion / Machines with automatic component loading features

The Clamping Elements are realised as follows:

Chuck clamping
The maximum dimension of the workpiece clamping diameter corresponds to the nominal diameter of the Clamping Element that has an E7 tolerance.

Mandrel clamping
The minimum dimension of the workpiece clamping diameter corresponds to the nominal diameter of the Clamping Element that has an E6 tolerance.

Tolerances E7 and e6 result in a minimum clearance for insertion that is adequate for manual assembly.

In case of automatic assembly, the centering accuracy of the handling unit during the assembly process must be taken into consideration. In addition to encreased loading cleareance a preguiding must be provided, it necessary, under no circumstances may there be any contact of componed and clamping element while loading / unloading. Please pay special attention to sealing and chip removal.

The catalogue contains information on the maximum change in diameter ΔD. for the respective Clamping Elements. As an additional clearance for insertion, this value can be realised minus the difference between the maximum and minimum dimensions of the clamping diameter at the workpiece. In this case, we ask you to specify the workpiece clamping diameter, the tolerance and the additional clearance for insertion to be taken into consideration.

Machine connection and actuating

The actuating forces and tightening torques for hand clamping listed in the tables discribe the load limit of the Clamping Element and must not be exceeded.

If the force exerted by the actuating device cannot be reduced below the load limit of the Clamping Element, two constructive possibilities can be realized to reduce the actuating force applied to the Clamping Element:

1. Actuating force with spring washer pack:

The required actuating force is applied with spring washers. The power clamping unit is used to release the Clamping Fixture by pressing the spring washers together and thus reducing the actuating force. When using rubberized Clamping Elements it is important to ensure that they are always stored or shut down after the completion of work with relaxed Clamping Elements or with clamped components (or control rings) in order to prevent relaxation of the rubber covering on the Clamping Elements.

2. Reducing the actuating force with an intermediate spring washer pack:

In this possibility, the actuating force is reduced and applied by an intermediate spring washer pack.

The values for actuating forces (longitudinal forces) and transmissible torques listed in the tables are virtually proportional.

Note for calculation of the max. transmissible torque of the Spring Force Actuator FUSR

When using a Spring Force Actuator FUSR, the max. transmissible torque of the Clamping Fixture is reduced. This is due to the lower actuating force of the Spring Force Actuator.

Clamping Chuck

$$M_{th} = \frac{F_f \cdot M_{max} \cdot D}{F_{max} \cdot D_{max}} \text{ [Nm]}$$

Clamping Mandrel

$$M_{th} = \frac{F_f}{F_{max}} \cdot M_{max} \text{ [Nm]}$$

Definition of terms used in these equations:

D = Clamping diameter of the component [mm]

D_{max} = max. clamping diameter of the Clamping Fixture size [mm]

M_{max} = max. transmissible torque of the Clamping Fixture size [Nm]

M_{th} = max. transmissible torque of the Spring Force Actuator [Nm]

F_f = min. spring force of the Spring Force Actuator [N]

F_{max} = max. actuating force of the Clamping Fixture size [N]

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Technical points

RINGSPANN®

for Bonded Disc Packs and Clamping Discs

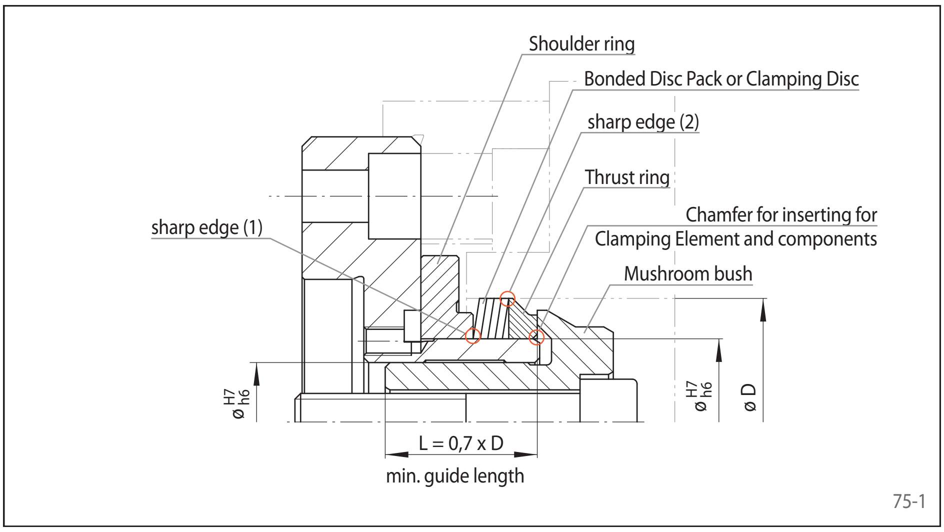
Guide length

In order to achieve a uniform enlargement or reduction of the clamping diameter around the entire circumference, a guide length of L ≥ 0,7 x D must be ensured for guide bushes, mushroom bushes, differential clamping bushes and intermediate bushes. D is the clamping diameter of the RINGSPANN Clamping Disc. In the case of Clamping Chucks, the actuating force can be achieved with a threaded ring. The threading on the chuck body and on the threaded ring must be free of play and runout against the functional surfaces. Achievable true run accuracy is much lower when threaded rings are used, however.

No chamfers and radii

The transition from the seating diameter to the contact suface for RINGSPANN Bonded Disc Packs or Clamping Discs must have a sharp edge (1) without rounding and without undercuts. This can be achieved by employing a sharp-edge ring, e.g. shoulder ring that covers the undercut.

The part that is pressed flat by the RINGSPANN Bonded Disc Packs or Clamping Discs, e.g. thrust ring during clamping must also have a runout-free ground circumferential sharp edge (2) in order to ensure that the entire circumferenc is pressed uniformly flat.



Fitting tolerances

Parts which slide against each other are produced with a fit tolerance of H7/h6. All parts must be checked for ease of movement. In order to avoid fit play, moveable bushes in or on which RINGSPANN Clamping Elements are seated must fit without clearance or in counter components. Thin-walled bushes can be deformed by pressure exerted by RINGSPANN Clamping Discs. Potential clamping can be prevented by free rotation inside the play-free glide surfaces in the seat area of the RINGSPANN Clamping Discs. In the case of Clamping Mandrels and Clamping Chucks, all diameters to which the component leads must be deisgned in accordance with the grinding dimension plus the tolerance (e6 or E7) of the Clamping Element.

No inadvertent expanding

When mounting components, it is essential to ensure that inadvertent expanding of the Bonded Disc Packs or Clamping Discs is avoided. Such expanding may be caused by impact of the component against the thrust ring or the mushroom bush. This problem applies especially to automatic loading systems. In this case, we advise against using thrust rings and special mushroom bushes (for mandrel clamping) and draw bushes (for chuck clamping). In the released position these special bushes must be held in axial position by the power clamping system, by springs or by other suitable means.

Maximum number of discs per pack

In the case of Clamping Disc packs with a large number of Clamping Discs, the Clamping Discs farthest from the source of axial force play only a reduced role in force transmission. A useful simplified rule is that discs in excess of a total of 16 contribute only about 50% to force transmission. Therefore, a number of discs must be added which is equavalent to calculated number of discs in excess of 16. Disc packs with more than 25 discs should be avoided.

Thrust rings

Thrust rings are have been finished with the same diameter and the same tolerance as RINGSPANN Clamping Discs and Bonded Disc Packs.

Technical points

RINGSPANN®

for Bonded Disc Packs and Clamping Discs

Transmissible torque, required actuating force

Parallel Bonded Disc Pack Clamping Fixtures

Parallel Bonded Disc Pack Clamping Fixtures grip the component at multiple clamping points of the same diameter. Bonded Disc Packs of equal thickness are used for this purpose. The total sum of all individual actuating forces exerted by the Bonded Disc Packs is required to actuate the Clamping Fixture. The total transmissible torque is equal to the sum of the transmissible torques of the Bonded Disc Packs.

Please consult with us with regard to configurations consisting of more than two Bonded Disc Packs.

Series Bonded Disc Pack Clamping Fixtures

Series Bonded Disc Pack Clamping Fixtures have two clamping points of equal diameter for gripping two identical components. The faces of both components must be in a parallel plane and runs without an error to the clamping diameter. When both components are clamped, both clamping points must be clamped in succession. This is achieved with the use of two disc packs of different thickness. The Bonded Disc Pack with the lower actuating force represents the actuating force of the Clamping Fixture. The thicker Bonded Disc Pack is clamped with the same actuating forces as the thinner Bonded Disc Pack. The simple transmissible torque of the thinner Bonded Disc Pack is applied to each clamping point.

Differential Bonded Disc Pack Clamping Fixtures

Differential Bonded Disc Pack Clamping Fixtures grip the component at two clamping points, which may have different diameters. When clamping the component, as with Series Bonded Disc Pack Clamping Fixtures, the individual clamping points are clamped in succession. This is achieved with the use of two Bonded Disc Packs of different thickness. The Bonded Disc Pack with the lower actuating force represents the actuating force of the Clamping Fixture and contributes its full catalogue torque to torque transmission. The thicker Bonded Disc Pack is clamped with the same actuating force as the thinner Bonded Disc Pack. The total transmissible torque of the clamping device is calculated as follows in units equipped with **an anti-twist lock** for the moveable seat of the broad Bonded Disc Pack.

$$M = M_I + M_{IIred} = M_I + M_{II} \frac{F_{mI}}{F_{mII}} \quad [Nm]$$

Definition of terms used in this equation:

F_{mI} = required actuating force of the thinner Bonded Disc Pack

F_{mII} = required actuating force of the thicker Bonded Disc Pack

M_I = maximum transmissible torque of the thinner Bonded Disc Pack

M_{IIred} = transmissible torque of the thicker Bonded Disc Pack at reduced actuating force F_{mI}

M_{II} = maximum transmissible torque of the thicker Bonded Disc Packs

Technical points

RINGSPANN®

Tolerances

Basic tolerances

Nominal dimensional range over … to	Basic tolerance degrees															
	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
	Basic tolerance															
mm	µm											mm				
to 3	0,8	1,2	2,0	3	4	6	10	14	25	40	60	0,10	0,14	0,25	0,40	0,6
3 … 6	1,0	1,5	2,5	4	5	8	12	18	30	48	75	0,12	0,18	0,30	0,48	0,75
6 … 10	1,0	1,5	2,5	4	6	9	15	22	36	58	90	0,15	0,22	0,36	0,58	0,9
10 … 18	1,2	2,0	3,0	5	8	11	18	27	43	70	110	0,18	0,27	0,43	0,70	1,1
18 … 30	1,5	2,5	4,0	6	9	13	21	33	52	84	130	0,21	0,33	0,52	0,84	1,3
30 … 50	1,5	2,5	4,0	7	11	16	25	39	62	100	160	0,25	0,39	0,62	1,00	1,6
50 … 80	2,0	3,0	5,0	8	13	19	30	46	74	120	190	0,30	0,46	0,74	1,20	1,9
80 … 120	2,5	4,0	6,0	10	15	22	35	54	87	140	220	0,35	0,54	0,87	1,40	2,2
120 … 180	3,5	5,0	8,0	12	18	25	40	63	100	160	250	0,40	0,63	1,00	1,60	2,5
180 … 250	4,5	7,0	10,0	14	20	29	46	72	115	185	290	0,46	0,72	1,15	1,85	2,9
250 … 315	6,0	8,0	12,0	16	23	32	52	81	130	210	320	0,52	0,81	1,30	2,10	3,2
315 … 400	7,0	9,0	13,0	18	25	36	57	89	140	230	360	0,57	0,89	1,40	2,30	3,6
400 … 500	8,0	10,0	15,0	20	27	40	63	97	155	250	400	0,63	0,97	1,55	2,50	4,0
500 … 630	9,0	11,0	16,0	22	32	44	70	110	175	280	440	0,70	1,10	1,75	2,80	4,4
630 … 800	10,0	13,0	18,0	25	36	50	80	125	200	320	500	0,80	1,25	2,00	3,20	5,0
800 … 1 000	11,0	15,0	21,0	28	40	56	90	140	230	360	560	0,90	1,40	2,30	3,60	5,6
1 000 … 1 250	13,0	18,0	24,0	33	47	66	105	165	260	420	660	1,05	1,65	2,60	4,20	6,6
1 250 … 1 600	15,0	21,0	29,0	39	55	78	125	195	310	500	780	1,25	1,95	3,10	5,00	7,8

Limits for selected tolerance ranges

Nominal dimension mm		E7 µm	F7 µm	H7 µm	e6 µm	f7 µm	h6 µm
		+ 24	+ 16	+ 10	– 14	- 6	0
to	3	+ 14	+ 6	0	– 20	- 16	– 6
over	3	+ 32	+ 22	+ 12	– 20	- 10	0
to	6	+ 20	+ 10	0	– 28	- 22	– 8
over	6	+ 40	+ 28	+ 15	– 25	- 13	0
to	10	+ 25	+ 13	0	– 34	- 28	– 9
over	10	+ 50	+ 34	+ 18	– 32	- 16	0
to	18	+ 32	+ 16	0	– 43	- 34	– 11
over	18	+ 61	+ 41	+ 21	– 40	- 20	0
to	30	+ 40	+ 20	0	– 53	- 41	– 13
over	30	+ 75	+ 50	+ 25	– 50	- 25	0
to	50	+ 50	+ 25	0	– 66	- 50	– 16
over	50	+ 90	+ 60	+ 30	– 60	- 30	0
to	80	+ 60	+ 30	0	– 79	- 60	– 19
over	80	+ 107	+ 71	+ 35	– 72	- 36	0
to	120	+ 72	+ 36	0	– 94	- 71	– 22
over	120	+ 125	+ 83	+ 40	– 85	- 43	0
to	180	+ 85	+ 43	0	– 110	- 83	– 25
over	180	+ 146	+ 96	+ 46	– 100	- 50	0
to	250	+ 100	+ 50	0	– 129	- 96	– 29
over	250	+ 162	+ 108	+ 52	– 110	- 56	0
to	315	+ 110	+ 56	0	– 142	- 108	– 32
over	315	+ 182	+ 119	+ 57	– 125	- 62	0
to	400	+ 125	+ 62	0	– 161	- 119	– 36
over	400	+ 198	+ 131	+ 63	– 135	- 68	0
to	500	+ 135	+ 68	0	– 175	- 131	– 40
over	500	+ 215	+ 146	+ 70	– 145	- 76	0
to	630	+ 145	+ 76	0	– 189	- 146	– 44
over	630	+ 240	+ 160	+ 80	– 160	- 80	0
to	800	+ 160	+ 80	0	– 210	- 160	– 50
over	800	+ 260	+ 176	+ 90	– 170	- 86	0
to	1000	+ 170	+ 86	0	– 226	- 176	– 56

Excerpt from VDI 2230, Page 1, issue of February 2003

Dimension	Assembly pretensioning force $F_{M\,Tab}$ in kN for $\mu_G = 0{,}12$			Tightening torques M_A in Nm for $\mu_K = \mu_G = 0{,}12$		
	Property classes			Property classes		
	8.8	10.9	12.9	8.8	10.9	12.9
M 4	4,4	6,5	7,6	3,0	4,6	5,1
M 5	7,2	10,6	12,4	5,9	8,6	10,0
M 6	10,2	14,9	17,5	10,1	14,9	17,4
M 7	14,8	21,7	25,4	16,8	24,7	28,9
M 8	18,6	27,3	32,0	24,6	36,1	42,2
M 10	29,6	43,4	50,8	48	71	83
M 12	43,0	63,2	74,0	84	123	144
M 14	59,1	86,7	101,5	133	195	229
M 16	80,9	118,8	139,0	206	302	354
M 18	102	145	170	295	421	492
M 20	130	186	217	415	592	692
M 22	162	231	271	567	807	945
M 24	188	267	267	714	1 017	1 190

Assembly pre-loading force $F_{M\,Tab}$ and tightening torques M_A at v = 0,9. For shaft screws with standard metric threading in accordance with DIN ISO 262. Head dimensions of hex screws in accordance with DIN EN ISO 4014 - 4018, socket hex screws in accordance with DIN 34800 and cylinder screws in accordance with DIN EN ISO 4762 and "medium" bore as defined in DIN EN 20273. • µG = thread, µK = screw head