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Machine tools — Mounting of grinding wheels by means of hub flanges

Machines-outils — Montage des meules par moyeux-flasques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 666 was prepared by Technical Committee ISO/TC 29, *Small tools*, Subcommittee SC 5, *Grinding wheels and abrasives*.

This third edition cancels and replaces the second edition (ISO 666:1996), which has been technically revised.

Machine tools — Mounting of grinding wheels by means of hub flanges

1 Scope

This International Standard specifies the essential requirements, especially dimensions, for hub flanges for plain grinding wheels according to ISO 603-1, ISO 603-2, ISO 603-4, ISO 603-6, ISO 603-7 and ISO 603-8 with a ratio of the bore diameter to the outside diameter $H/D > 0{,}2$. It is also applicable for super abrasives with vitrified or metal core having the same diameters as the grinding wheels according to those parts of ISO 603, independently from the material of the core. It applies to grinding wheels with peripheral speeds up to 50 m/s and driving powers of the wheel spindle up to 30 kW.

It is not applicable to mounting devices for cutting-off wheels.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 603-1:1999, *Bonded abrasive products — Dimensions — Part 1: Grinding wheels for external cylindrical grinding between centres*

ISO 603-2:1999, *Bonded abrasive products — Dimensions — Part 2: Grinding wheels for centreless external cylindrical grinding*

ISO 603-4:1999, *Bonded abrasive products — Dimensions — Part 4: Grinding wheels for surface grinding/peripheral grinding*

ISO 603-6:1999, *Bonded abrasive products — Dimensions — Part 6: Grinding wheels for tool and tool room grinding*

ISO 603-7:1999, *Bonded abrasive products — Dimensions — Part 7: Grinding wheels for manually guided grinding*

ISO 603-8:1999, *Bonded abrasive products — Dimensions — Part 8: Grinding wheels for deburring and fettling/snagging*

ISO 702-1:2001, *Machine tools — Connecting dimensions of spindle noses and work holding chucks — Part 1: Conical connection*

ISO 1119:1998, *Geometrical Product Specifications (GPS) — Series of conical tapers and taper angles*

ISO 2768-1:1989, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 4762:2004, *Hexagon socket head cap screws*

ISO 6103:2005, *Bonded abrasive products — Permissible unbalances of grinding wheels as delivered — Static testing*

ISO 12164-1:2001, *Hollow taper interface with flange contact surface — Part 1: Shanks — Dimensions*

ISO 12164-2:2001, *Hollow taper interface with flange contact surface — Part 2: Receivers — Dimensions*

ISO 13942:2000, *Bonded abrasive products — Limit deviations and run-out tolerances*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
hub flange
system of fixed and loose flanges for a friction mounting of grinding wheels on a wheel spindle where a securing system for frictional or positive connection with the wheel spindle is integrated into the fixed flange and the clamping force is applied via several screws arranged on a pitched circle

3.2
fixed flange
part of the hub flange, by means of which the frictional or positive connection to the wheel spindle is established

NOTE For CNC grinding machines, its contact area with the grinding wheel (annular surface) serves as reference surface for the determination of the position of the grinding wheel on the spindle.

3.3
loose flange
counterflange
flange which represents the counterpart to the fixed flange and has to be removed for the mounting/demounting of the grinding wheel (on/from the wheel spindle or the hub flange)

3.4
flange socket
part of the fixed flange, by means of which the frictional or positive connection to the wheel spindle is established (interface with the wheel spindle)

3.5
spindle socket
part of the wheel spindle by means of which the frictional or positive connection to the hub flange is established (interface with the hub flange)

4 Requirements

4.1 General

The hub flanges according to ISO 666 are designed for the specified outside diameters, thicknesses and bores of the grinding wheels according to Table 1 for the transmission of the following driving powers of the wheel spindle:

— 3 kW for grinding wheel diameters $D = 200$ mm to $D = 356$ mm;

— 7 kW for grinding wheel diameters $D = 400$ mm to $D = 508$ mm;

— 15 kW for grinding wheel diameters $D = 600$ mm to $D = 762$ mm;

— 30 kW for grinding wheel diameters $D = 800$ mm to $D = 1\,250$ mm.

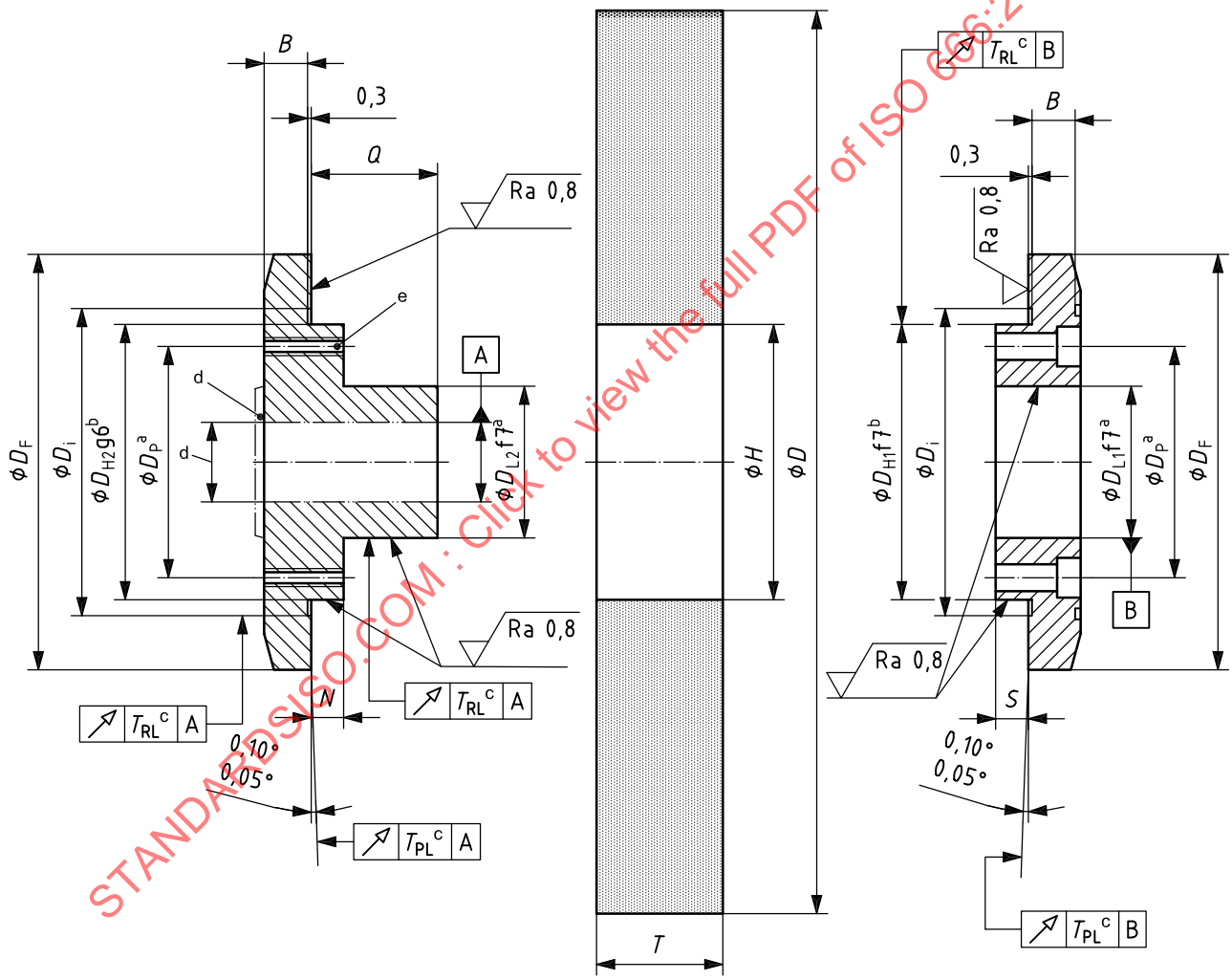
4.2 Dimensions

For the dimensions of hub flanges, see Figure 1 and Table 1.

For the dimensions of flange sockets, see Figures 2 to 6 and Table 2.

Details not mentioned shall be chosen to the intended use. This includes position and geometry of the groove for the balancing weights and the pitch diameter of the screw mounting system. The latter should be chosen as large as possible.

Dimensions in millimetres
General tolerances ISO 2768-m
Surface roughness in micrometres



a The diameters $\varnothing D_{L\,1}$, $\varnothing D_{L\,2}$ and $\varnothing D_p$ are left to the manufacturer's discretion.

b $\varnothing D_{H\,1}$ and $\varnothing D_{H\,2}$ correspond to the nominal grinding wheel diameter H.

c T_{PL}, $T_{RL} \leqslant$ 0,03 mm for grinding wheels according to ISO 603-2, ISO 603-4 ISO 603-6, ISO 603-7 and ISO 603-8, and for super abrasives with vitrified core.

T_{PL}, $T_{RL} \leqslant$ 0,01 mm for super abrasives with metal core.

d Flange socket A, BF, BM, CF or CM.

e X (pitch of threaded holes) × Z.

Figure 1 — Hub flange

Table 1 — Dimensions of grinding wheels and hub flanges

Grinding wheel				Hub flange						Number and size of screws [d]	
D [a]	T [a]		H [a]	D_F	D_i	B	N	S	Q	Z	Hexagon socket head cap screw according to ISO 4762:2004
	min.	max.				min.	min.	min.			
200	13	20	50,8	85	60	6	5		T [c] + 6 mm min.	4	M5
250	20	40									
200	25	125	76,2	115	85	8	5			6	M5
250	20	40									
300	20	80									
350/356	32	80		125							
250	20	250	127	165	137	10	6			6	M6
300	20	250									
350/356	25	600		175		12				6	M8
400/406	32	100									
450/457	32	80		185	140	13					
500/508	50	80		191							
600/610	50	80		210	145	14				8	
250	25	250	152,4	180	162	10	6			6	M8
300	40	250									
350/356	100	600		190	162	12					
400/406	40	50		196	165	12					
450/457	40	63		204		13					
500/508	40	80		212	170						
350/356	b	b	160 [b]	202	170	12	6			6	M8
400/406											
450/457				220	170	13					
500/508											
400/406	25	250	203,2	240	215	12	8			8	M8
450/457	32	80		260		13					
500/508	40	63									
600/610	20	100		272		14				8	M10
750/762	63	100		300	230	16					
500/508	25	600	304,8	365	315	15	10			8	M12
600/610	20	600									
750/762	20	600		382	320	16					
800/813	20	150		410	330	18				10	M12
900/914	20	152									
1 060/1 067	20	150		435	330	22					
900/914	20	150	406,4	492	420	25	15			10	M16
1 060/1 067	20	150		520							
1 060/1 067	63	150	508	602	530	25	15			10	M16
1 250	63	150		635							

[a] Dimensions according to ISO 603-1, to ISO 603-2, to ISO 603-4, to ISO 603-6, to ISO 603-7 and ISO 603-8, limit deviations and run-out tolerances according to ISO 13942.

[b] Grinding wheels with $H = 160$ mm are mainly used for the grinding of flanks of gear teeth and threads; they are not standardized in ISO 603-1, ISO 603-2, ISO 603-4, ISO 603-6, ISO 603-7 or ISO 603-8.

[c] Dimension T is the actual size of the grinding wheel thickness.

[d] Method for the calculation of the necessary clamping force and screw tightening torques, see Annex A.

4.3 Flange socket

The interface of the fixed flange and the wheel spindle cannot be specified in detail in this International Standard. In the following, different flange sockets are presented in Figures 2 to 6 and preferred number series for nominal sizes are given in Table 2.

This representation of flange sockets enables an unambiguous definition of the interface flange/wheel spindle and the limitation of the variety of flange sockets.

The presented flange sockets shall be favoured in use.

Type A

Flange socket for spindle with taper shank 1:10 according to ISO 1119:1998

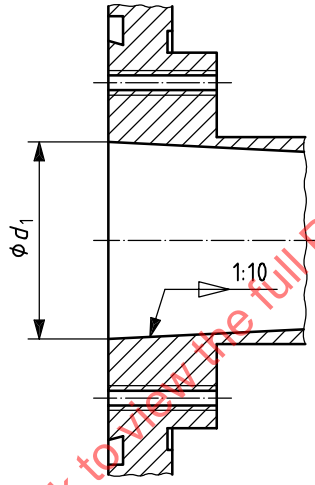


Figure 2 — Taper 1:10

Type BF

Flange socket for spindle with taper shank 1:4 according to ISO 702-1:2001

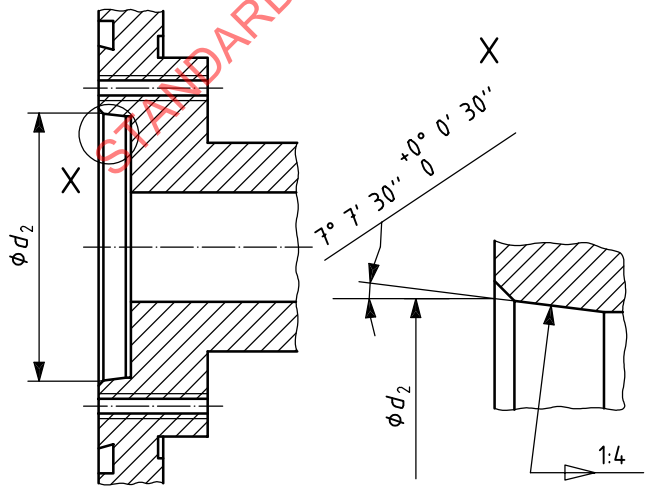


Figure 3 — Short taper 1:4 (female taper)

Type BM

Flange socket for spindle with taper sleeve 1:4 according to ISO 702-1:2001

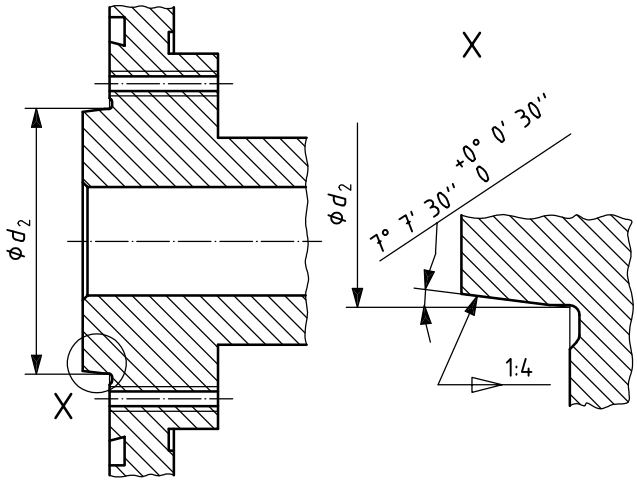


Figure 4 — Short taper 1:4 (male taper)

Type CF

Flange socket for spindle with hollow taper shank 1:10 according to ISO 12164-2:2001

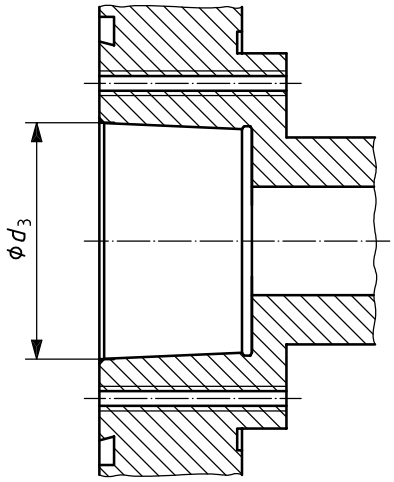


Figure 5 — Taper 1:10 (female taper)

Type CM

Flange socket for spindle with hollow taper sleeve 1:9,98 according to ISO 12164-1:2001

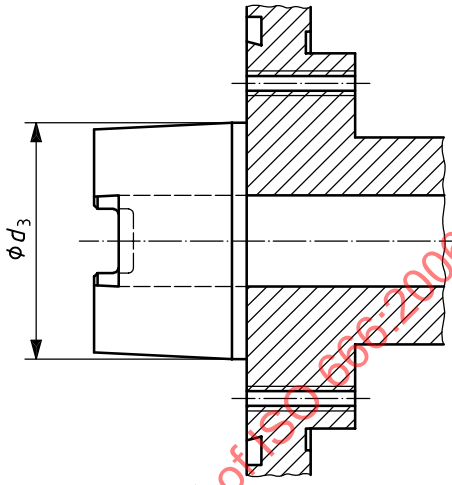


Figure 6 — Taper 1:9,98 (male taper)

4.4 Material

Steel with a minimum tensile strength of 500 N/mm^2, type is left to the manufacturer's discretion.

4.5 Marking

Hub flanges according to this International Standard shall be marked with the following characteristics.

a) Loose flange:

- ISO 666;
- maximum outside diameter D of the grinding wheel;
- bore diameter H of the grinding wheel.

b) Fixed flange:

- ISO 666;
- maximum outside diameter D of the grinding wheel;
- clamping area T of the hub flange;
- bore diameter H of the grinding wheel;
- manufacturer or supplier.

Table 2 — Connecting dimensions of flange sockets

Grinding wheel		Flange socket		
		Type A	Types BF and BM	Types CF and CM
D	H	d_1	d_2 [a]	d_3 [b]
200	50,8	40	53,975	48,01
250				
200	76,2	40 and 63	53,975 and 63,513	48,01 and 60,012
250				
300				
350/356				
250	127			
300				
350/356				
400/406				
450/457				
500/508				
600/610				
250	152,4	80	82,563	75,013
300				
350/356				
400/406				
450/457				
500/508				
350/356	160			
400/406				
450/457				
500/508				
400/406	203,2			
450/457				
500/508				
600/610				
750/762				
500/508	304,8	100	106,375	95,016
600/610				
750/762				
800/813		120	139,719	120,016
900/914				
1 060/1 067				
900/914	406,4			
1 060/1 067				
1 060/1 067	508			
1 250				

[a] Complete dimensions according to ISO 702-1:2001.

[b] Complete dimensions according to ISO 12164-1:2001 and ISO 12164-2:2001.

5 Designation

Hub flanges according to this International Standard are designated as follows:

a) “Hub flange”;

b) reference to this International Standard, i.e. ISO 666;

c) type of flange socket (A, BF, BM, CF or CM);

d) diameter d_1, d_2 or d_3;

e) dimensions of the grinding wheel D, T and H.

EXAMPLE A hub flange with flange socket Type A, $d_1 = 63$ mm for plain grinding wheels, and with $D = 400$ mm, $T = 32$ mm to 100 mm and $H = 127$ mm, is designated as follows:

Hub flange ISO 666 A63 - 400 × 32/100 × 127

6 Scope of delivery

The delivery of the hub flange includes fixed flange, loose flange and associated head cap screws according to Table 1. The length of the head cap screws depends on the thickness of the grinding wheel to be mounted.

Annex A
(informative)

Calculation of clamping force and tightening torque for mounting of abrasive products by means of flanges

A.1 Symbols

A_F	supporting surface of the hub flange	mm^2
A_s	stressed cross section of the screws	mm^2
D	outside diameter of the grinding wheel	mm
D_F	outside diameter of the hub flange	mm
D_m	mean clamping diameter	mm
d	nominal diameter of the screw	mm
d_0	diameter of the smallest screw cross-section	mm
d_2	flange diameter of the thread	mm
F_B	local operating force	N
F_E	local clamping force	N
F_G	weight	N
F_T	shearing force at the hub flange mean clamping diameter	N
F_r	radial contact force	N
F_t	cutting force	N
F_u	centrifugal force due to unbalance	N
g	acceleration due to gravity	m/s^2
K	coefficient for the calculation of the unbalance mass	—
K_α	tightening factor [1)]	—
K_β	correction value for the influence of the flange camber [1)]	—
K_γ	correction factor for the influence of settlement effects [1)]	—
K_δ	correction factor taking account of vibrations and impacts independent from the grinding procedure [1)]	—
k_r	ratio of radial contact force and cutting force [1)]	—
k_1	factor taking account of the breakdown torque	—
M	mass of the grinding wheel	kg
M_A	tightening torque of a screw	N·m
M_G	thread torque of a screw	N·m
m	unbalance mass according to ISO 6103	g

1) The manufacturer should indicate the tightening method and the values of the factors to be used on each type of machine for the grinding operations possible corresponding to the practice.

P_N	nominal power of the wheel spindle	W
p	surface pressure	N/mm^2
R	clamping width	mm
$R_{p0,2}$	0,2 % proof stress	N/mm^2
r_K	effective radius for the moment of friction in the contact surface of the head	mm
v_s	maximum operating speed	m/s
W_p	polar section modulus of the screw	mm^3
Z	number of clamping screws	—
α	helix angle of thread	°
μ_G	coefficient of friction of the thread	—
μ_H	coefficient of friction between flange and grinding wheel	—
μ_K	coefficient of friction in the contact surface of the clamping screw	—
ρ_G	thread angle of friction	°
σ_v	reduced stress	N/mm^2
σ_z	tensile stress	N/mm^2
τ_t	torsional stress	N/mm^2

A.2 Operating forces

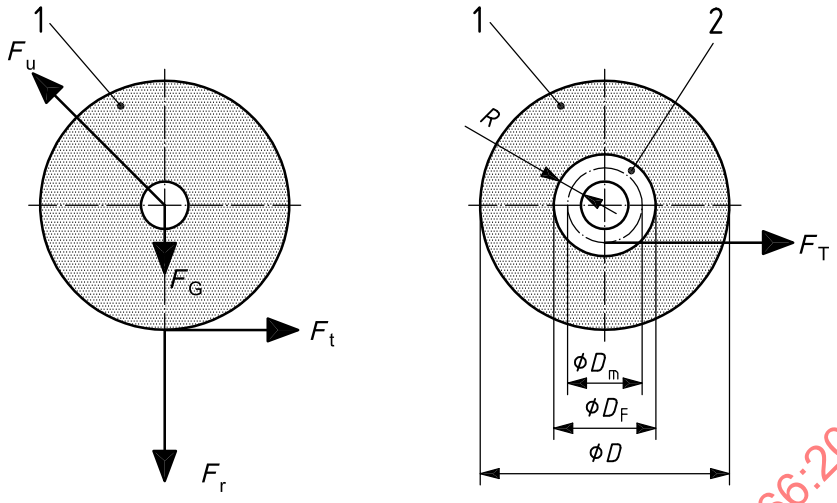
For the approximate calculation of the necessary clamping force and the tightening torque, the following four forces shall be taken into account (Figure A.1):

— weight F_G of the wheel;

— centrifugal force F_u due to unbalance of the wheel;

— radial contact force F_r, with which the wheel presses against the workpiece;

— shearing force F_T at the mean clamping diameter due to the cutting force F_t.



Key

1 grinding wheel
2 clamping area

Figure A.1 — Operating forces

The weight F_G is calculated by

$$F_G = M \cdot g \tag{A.1}$$

The centrifugal force F_u due to unbalance is calculated by

$$F_u = 2 \cdot m \cdot \frac{v_s^2}{D} \tag{A.2}$$

where

$$m = K \cdot \sqrt{M} \quad \text{according to ISO 6103} \tag{A.3}$$

IMPORTANT — In Equation (A.3), the mass M in g shall be inserted!

The radial contact force F_r, is calculated by

$$F_r = k_r \cdot F_t \tag{A.4}$$

where

$$F_t = k_1 \cdot \frac{P_N}{v_s} \tag{A.5}$$

For the factor k_r as ratio of radial contact force and cutting force, the following values can be assumed:

$k_r = 2$ to 3 for precision grinding;

$k_r = 3$ to 5 for rough grinding;

$k_r = 5$ to 10 for high pressure rough grinding.

The factor k_1 in Equation (A.5) takes account of the fact that the breakdown torque, which, when exceeded, results in the breakdown of the driving motor of the wheel spindle, is higher than the nominal torque. For standard three-phase motors, a value $k_1 = 2{,}5$ can be assumed.

At the mean clamping diameter $D_m = D_F - R$ of the hub flange, the cutting force F_t generates the shearing force F_T:

$$F_T = k_1 \cdot \frac{P_N}{v_s} \cdot \frac{D}{D_F - R} \tag{A.6}$$

Roughly simplified, and if the four forces F_G, F_u, F_r and F_T are assumed to act in one direction, the highest total operating force F_B results in

$$F_B = F_G + F_u + F_r + F_T \tag{A.7}$$

NOTE For symbols, see A.1.

A.3 Necessary clamping force

The total clamping force F_E necessary for the prevention of slippage of the wheel between the flanges can thus be calculated as follows:

$$F_E = \frac{F_G + F_u + F_r + F_T}{\mu_H} \cdot K_\alpha \cdot K_\beta \cdot K_\gamma \cdot K_\delta \tag{A.8}$$

For the coefficient μ_H, values between 0,15, e.g. for plastic blotters, and 0,25, e.g. for cardboard blotters, can be assumed.

The tightening factor K_α takes account the scatter of the clamping force owing to technical inaccuracies during tightening and to different friction conditions in the screw connection. The coefficients of friction depend among others on the surface quality, the lubrication conditions and the state of the screws. Table A.1 contains approximate values for the tightening factor.

K_β is a correction factor taking account of the flange camber. For K_β a value of 1,1 can be assumed.

The correction factor K_γ takes account of the influence of setting effects on the total clamping force. For K_γ a value of 1,6 can be taken as basis.

K_δ is a correction factor taking account of the influence of impacts and vibrations. For K_δ the following values can generally be assumed as a function of the grinding method:

$K_\delta = 1{,}0$ for precision grinding;

$K_\delta = 1{,}5$ for rough grinding;

$K_\delta = 2{,}0$ for high pressure rough grinding.