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ISO 666

Fourth edition
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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

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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 fourth edition cancels and replaces the third edition (ISO 666:2006), which has been technically revised.

The significant modifications are the following:

a) in 4.2, Figure 1, the tolerance class of the outer diameter, D_{H2}, of the fixed flange has been changed to f6; consequently, the tolerance class of the outer diameter, D_{H1}, of the loose flange has been changed to e7, in order to avoid possible safety problems, in particular, for bonded abrasive products in cases where the minimum permitted clearance between the hole, H, of the grinding wheel and the diameter, D_{H2}, of the flange is reached and can lead to tangential tensile stress in the wheel;

b) in 4.2, Figure 1, the tolerance for the concavity of the flange's part supporting the wheel has been reduced, in order to obtain a better distribution of the tightening forces on the wheel's contact surface.

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

1 Scope

This International Standard specifies the essential requirements, especially the 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 to super abrasives with vitrified or metal core having the same diameters as the grinding wheels in accordance with the according to the aforementioned 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Bonded abrasive products — Dimensions — Part 1: Grinding wheels for external cylindrical grinding between centres*

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

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

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

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

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

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

ISO 1119, *Geometrical product specifications (GPS) — Series of conical tapers and taper angles*

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

ISO 4762, *Hexagon socket head cap screws*

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

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

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

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

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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 the reference surface for the determination of the position of the grinding wheel on the spindle.

3.3
loose flange
counterflange
flange that 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 in accordance with this International Standard 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 according to the intended use. This includes the 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.

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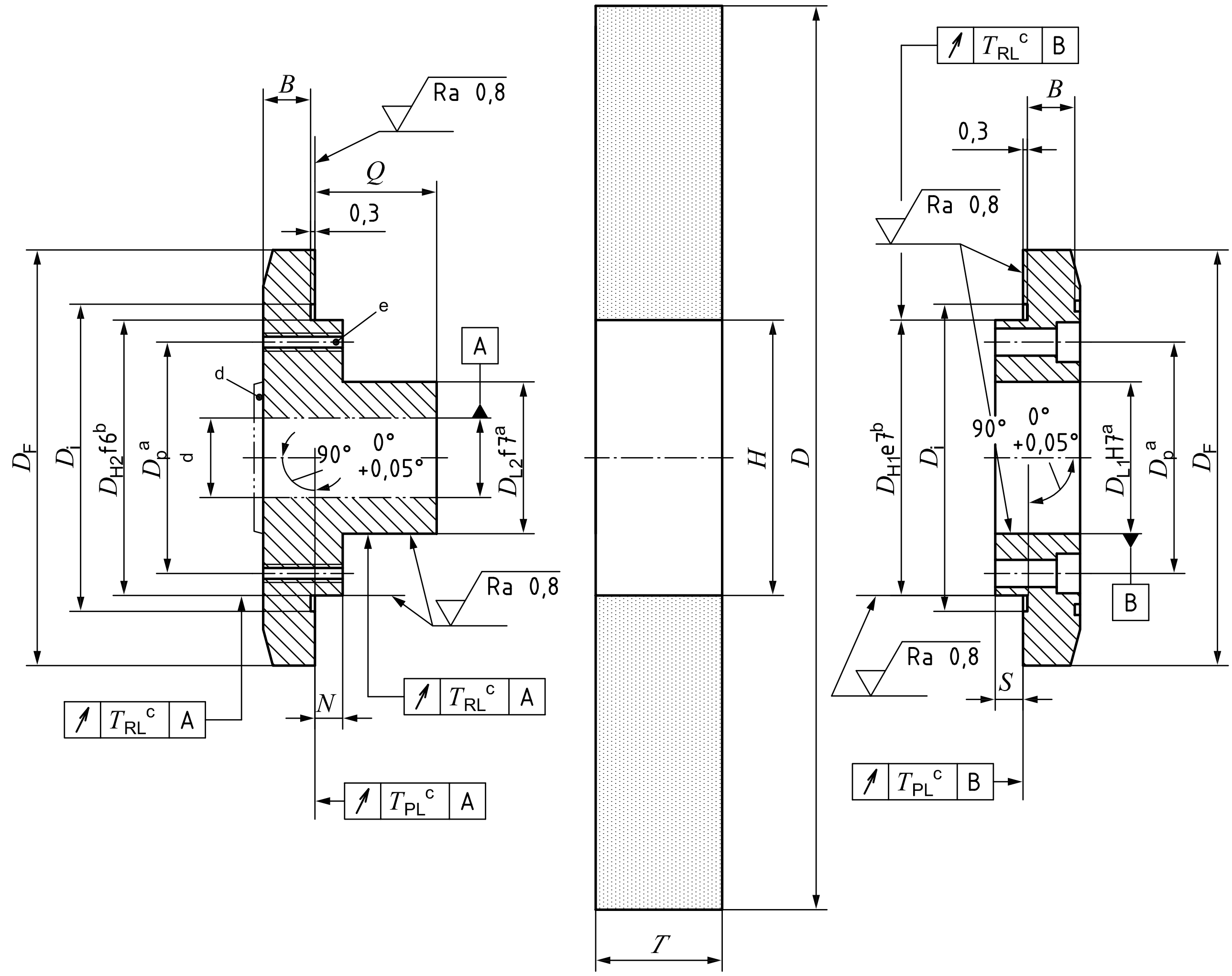
Dimensions in millimetres
General tolerances ISO 2768-m
Surface roughness in micrometres



a The diameters D_{L1}, D_{L2} and D_p are left to the manufacturer's discretion.

b D_{H1} and D_{H2} correspond to the nominal bore diameter, H, of the grinding wheel.

c T_{PL}, T_{RL} ≤ 0,03 mm for grinding wheels in accordance with 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} ≤ 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

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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 in accordance with ISO 4762
	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					

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Table 1 *(continued)*

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 in accordance with ISO 4762
	min.	max.				min.	min.	min.			
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 in accordance with ISO 603-1, ISO 603-2, ISO 603-4, ISO 603-6, ISO 603-7 and ISO 603-8; limit deviations and run-out tolerances in accordance with 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] The method for calculating the necessary clamping force and screw-tightening torques is given in 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 flange sockets presented shall be favoured in use.

a) Type A: flange socket for spindle with taper shank 1:10 in accordance with ISO 1119.

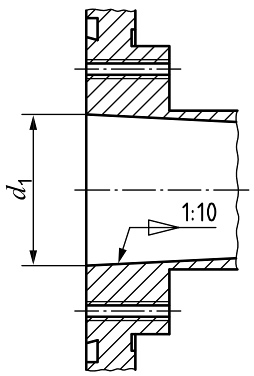

Figure 2 — Taper 1:10

b) Type BF: flange socket for spindle with taper shank 1:4 in accordance with ISO 702-1.

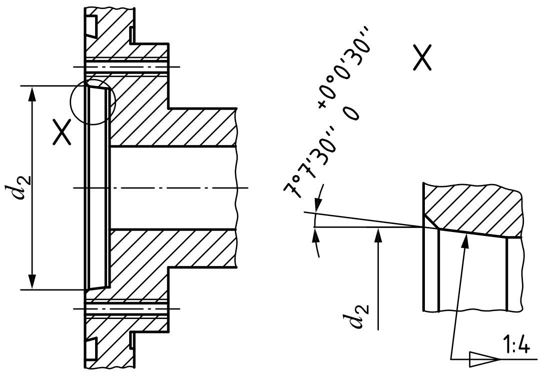

Figure 3 — Short taper 1:4 (female taper)

c) Type BM: flange socket for spindle with taper sleeve 1:4 in accordance with ISO 702-1.

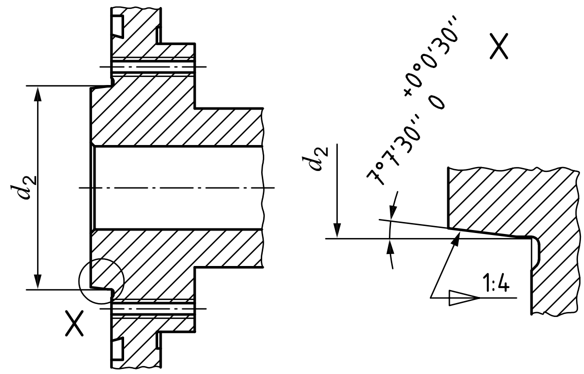

Figure 4 — Short taper 1:4 (male taper)

d) Type CF: flange socket for spindle with hollow taper shank 1:10 in accordance with ISO 12164-2.

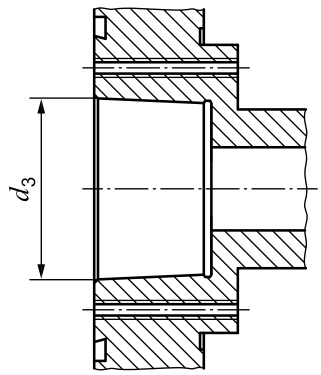

Figure 5 — Taper 1:10 (female taper)

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e) Type CM: flange socket for spindle with hollow taper sleeve 1:9,98 in accordance with ISO 12164-1.

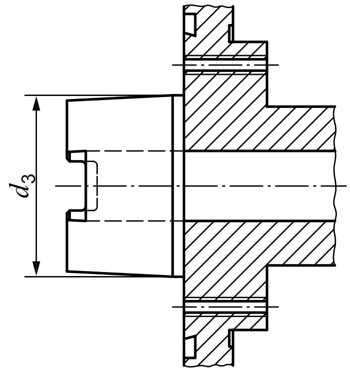

Figure 6 — Taper 1:9,98 (male taper)

4.4 Material

The material is steel with a minimum tensile strength of 500 N/mm^2; the type is left to the manufacturer's discretion.

4.5 Marking

Hub flanges in accordance with this International Standard shall be marked with the following characteristics.

a) Loose flange:

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

   2) maximum outside diameter, D, of the grinding wheel;

   3) bore diameter, H, of the grinding wheel.

b) Fixed flange:

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

   2) maximum outside diameter, D, of the grinding wheel;

   3) clamping area, T, of the hub flange;

   4) bore diameter, H, of the grinding wheel;

   5) identification of the manufacturer or supplier.

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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 in accordance with ISO 702-1.

[b] Complete dimensions in accordance with ISO 12164-1 and ISO 12164-2.

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5 Designation

Hub flanges in accordance with 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 the 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.

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Annex A
(informative)

Calculation of clamping force and tightening torque for the 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	—
K_β	correction value for the influence of the flange camber	—
K_γ	correction factor for the influence of settlement effects	—
K_δ	correction factor taking account of vibrations and impacts independent from the grinding procedure	—
k_r	ratio of radial contact force and cutting force	—
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

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M_G	thread torque of a screw	N·m
m	unbalance mass in accordance with ISO 6103	g
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

NOTE For K_α, K_β, K_γ, K_δ and k_r, it is the responsibility of the manufacturer to indicate the tightening method and the values of the factors to be used on each type of machine for the possible grinding operations corresponding to practice.

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.

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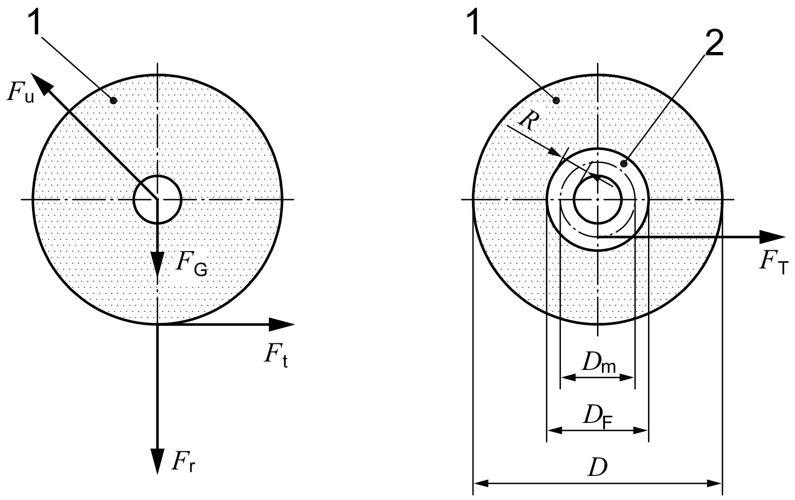

Key

1 grinding wheel

2 clamping area

Figure A.1 — Operating forces

The weight, F_G, is calculated using Formula (A.1):

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

The centrifugal force, F_u, due to unbalance is calculated using Formula (A.2):

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

where

$$m = K \cdot \sqrt{M} \tag{A.3}$$

in accordance with ISO 6103.

IMPORTANT — In Formula (A.3), the mass, M, in grams, shall be inserted.

The radial contact force, F_r, is calculated using Formula (A.4):

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

where

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

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

— $k_r = 2$ to 3 for precision grinding;

— $k_r = 3$ to 5 for rough grinding;

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— k_r = 5 to 10 for high-pressure rough grinding.

Factor k_1 in Formula (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 of 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 other things, 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 the 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_δ = 1,0 for precision grinding;

— K_δ = 1,5 for rough grinding;

— K_δ = 2,0 for high-pressure rough grinding.

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Table A.1 — Approximate values for tightening factor K_α

<table>
<tr><th>Tightening factor
K_α</th><th>Scatter of clamping force
N</th><th>Tightening method</th><th>Adjustment method</th><th colspan="2">Remarks</th></tr>
<tr><td>1,2 to 1,6</td><td>±9 to ±23</td><td>Hydraulic tightening</td><td>Adjustment via measurement of length or pressure</td><td colspan="2">Lower values for long screws ($l_k/d \geq 5$)
Higher values for short screws ($l_k/d \leq 2$)
l_k: clamping length</td></tr>
<tr><td>1,4 to 1,6</td><td>±17 to ±23</td><td>Torque-controlled tightening with dynamometric key, torque wrench or precision screw driver with dynamic torque measuring</td><td>Practical determination of the rated tightening torques at the original threaded joints, e.g. by measurement of the screw elongation</td><td>Lower values for a high number of adjustment or control tests (e.g. 20). Small scatter of the released torque. Electronic torque limiting during mounting for precision screw drivers</td><td rowspan="3">Lower values for:
— small turning angles, i.e. relatively stiff connections
— relatively soft counterpart
— counterparts which have no tendency to seize, e.g. phosphatized
Higher values for:
— high turning angles, i.e. relatively flexible connections and fine screw threads
— large hardness of the counterpart, in connection with rough surface
— surface unevenness</td></tr>
<tr><td>1,6 to 1,8</td><td>±23 to ±28</td><td></td><td>Determination of the rated tightening torque by estimation of the coefficient of friction (surface and lubrication conditions)</td><td>Lower values for measuring dynamometric keys:
— continuous tightening
— precision screw drivers
Higher values for torque wrenches</td></tr>
<tr><td>1,7 to 2,5</td><td>±26 to ±43</td><td>Torque-controlled tightening with screw driver</td><td>Adjustment of the screw driver with retightening torque calculated from the rated tightening torque (for estimated coefficient of friction) and an addition</td><td>Lower values for:
— large number of control tests (retightening torque)
— screw drivers with overload coupling</td></tr>
<tr><td>2,5 to 4,0</td><td>±43 to ±60</td><td>Pulse-controlled tightening with impact screw driver</td><td>Adjustment of the screw driver with retightening torque, as above</td><td>Lower values for:
— large number of adjustment tests (retightening torque)
— on horizontal part of the screw driver characteristic curve
— pulse transmission free from play</td><td></td></tr>
</table>

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A.4 Tightening torque of screws

The necessary clamping force, F_E, in accordance with Formula (A.8) shall be exerted by the clamping screws of the hub flange. The tightening torque necessary for the tightening of the individual screws results from Formula (A.9):

$$M_A = \frac{F_E}{Z} \cdot \left[\frac{d_2}{2} \cdot \text{tg}\,(\alpha + \rho_G) + r_K \cdot \mu_K \right] \quad \text{(A.9)}$$

where

$$\mu_G = \text{tg}\,\rho_G \quad \text{(A.10)}$$

It is necessary to point out that activities, e.g. vibration activities, can occur during grinding; the simple Formula (A.9) above does not take these activities into account satisfactorily. They can result in a loosening of the screw connection. The loosening hazard can be essentially minimized by exhausting the yield point of the used screws to the largest possible extent; however, not by more than 90 %. On the basis of the hypothesis on the energy resulting from shape modification, the following strength condition shall be fulfilled:

$$\sigma_v = \sqrt{\sigma_z^2 + 3 \cdot \tau_t^2} \leq 0{,}9 R_{p0,2} \quad \text{(A.11)}$$

where

$$\sigma_z = \frac{F_E}{A_s \cdot Z} \quad \text{(A.12)}$$

$$\tau_t = \frac{M_G}{W_p} \quad \text{(A.13)}$$

$$M_G = \frac{F_E}{Z} \cdot \left[\frac{d_2}{2} \cdot \text{tg}\left(\alpha + \rho_G\right) \right] \quad \text{(A.14)}$$

$$W_p = \frac{\pi}{16} \cdot d_0^3 \quad \text{(A.15)}$$

A.5 Surface pressure

Subsequently, with the clamping force, F_E, calculated or resulting from the chosen tightening torque, and the clamping surface, A_F, of the hub flange, the surface pressure:

$$p = \frac{F_E}{A_F} \quad \text{(A.16)}$$

between the hub flange and the wheel shall be determined. The surface pressure determined in this way shall not lead to damage of the wheel.

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