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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 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.

# 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*

### 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:

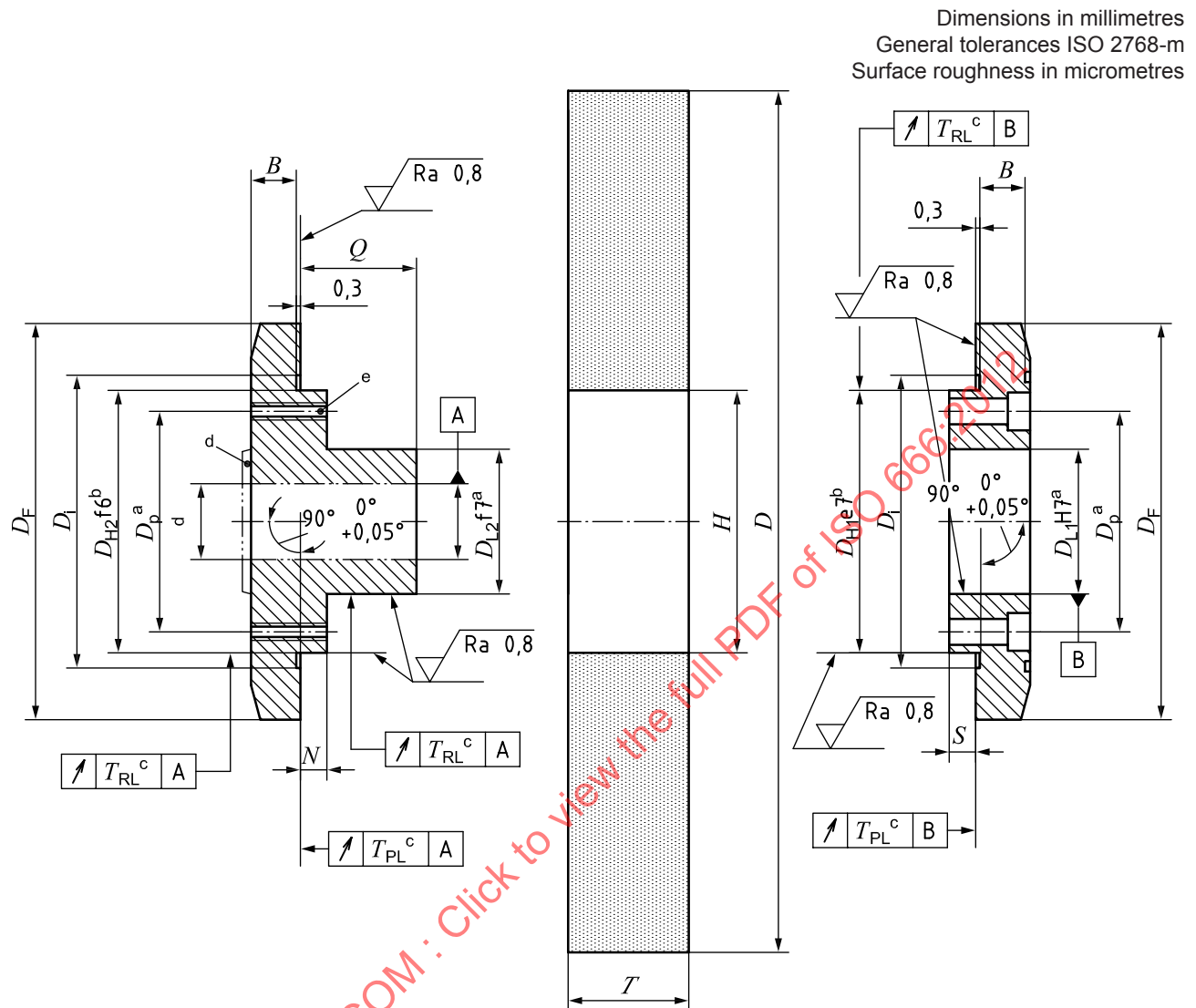
- 3 kW for grinding wheel diameters  $D = 200$  mm to  $D = 356$  mm;
- 7 kW for grinding wheel diameters  $D = 400$  mm to  $D = 508$  mm;
- 15 kW for grinding wheel diameters  $D = 600$  mm to  $D = 762$  mm;
- 30 kW for grinding wheel diameters  $D = 800$  mm to  $D = 1\,250$  mm.

#### 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.



- 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  $T_{PL}$ ,  $T_{RL} \leq 0,03$  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.  $T_{PL}$ ,  $T_{RL} \leq 0,01$  mm for super abrasives with metal core.
- d Flange socket A, BF, BM, CF or CM.
- e  $X$  (pitch of threaded holes)  $\times Z$ .

Figure 1 — Hub flange

Table 1 — Dimensions of grinding wheels and hub flanges

| Grinding wheel |       |      | Hub flange       |       |       |      |      |      |     | Number and size of screws <sup>d</sup> |                                                           |
|----------------|-------|------|------------------|-------|-------|------|------|------|-----|----------------------------------------|-----------------------------------------------------------|
| $D^a$          | $T^a$ |      | $H^a$            | $D_F$ | $D_i$ | $B$  | $N$  | $S$  | $Q$ | $Z$                                    | Hexagon socket head cap screw in accordance with ISO 4762 |
|                | min.  | max. |                  |       |       | min. | min. | min. |     |                                        |                                                           |
| 200            | 13    | 20   | 50,8             | 85    | 60    | 6    | 5    |      |     | 4                                      | M5                                                        |
| 250            | 20    | 40   |                  |       |       |      |      |      |     |                                        |                                                           |
| 200            | 25    | 125  |                  |       |       |      |      |      |     |                                        |                                                           |
| 250            | 20    | 40   | 76,2             | 115   | 85    | 8    | 5    |      |     | 6                                      | M5                                                        |
| 300            | 20    | 80   |                  |       |       |      |      |      |     |                                        |                                                           |
| 350/356        | 32    | 80   |                  |       |       |      |      |      |     |                                        |                                                           |
| 250            | 20    | 250  | 127              | 165   | 137   | 10   | 6    |      |     | 6                                      | M6                                                        |
| 300            | 20    | 250  |                  |       |       |      |      |      |     |                                        |                                                           |
| 350/356        | 25    | 600  |                  | 175   | 12    | 6    |      |      |     |                                        |                                                           |
| 400/406        | 32    | 100  |                  |       |       |      |      |      |     |                                        |                                                           |
| 450/457        | 32    | 80   |                  | 185   | 140   |      |      |      |     |                                        | 13                                                        |
| 500/508        | 50    | 80   |                  |       |       |      |      |      |     |                                        |                                                           |
| 600/610        | 50    | 80   |                  | 210   | 145   | 14   |      |      |     |                                        |                                                           |
| 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   |                  |       |       |      |      |      |     |                                        |                                                           |
| 450/457        | 40    | 63   |                  | 204   | 170   | 13   |      |      |     |                                        |                                                           |
| 500/508        | 40    | 80   |                  |       |       |      |      |      |     |                                        |                                                           |
| 350/356        | b     | b    | 160 <sup>b</sup> | 202   | 170   | 12   | 6    |      |     | 6                                      | M8                                                        |
| 400/406        |       |      |                  |       |       |      |      |      |     |                                        |                                                           |
| 450/457        |       |      |                  |       |       |      |      |      |     |                                        |                                                           |
| 500/508        |       |      |                  |       |       |      |      |      |     |                                        |                                                           |
| 400/406        | 25    | 250  | 203,2            | 240   | 215   | 12   | 8    |      |     | 8                                      | M8                                                        |
| 450/457        | 32    | 80   |                  |       |       |      |      |      |     |                                        |                                                           |
| 500/508        | 40    | 63   |                  | 260   |       | 13   |      |      |     |                                        |                                                           |
| 600/610        | 20    | 100  |                  |       |       |      |      |      |     |                                        |                                                           |
| 750/762        | 63    | 100  |                  | 300   |       | 230  |      |      |     |                                        |                                                           |
| 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                                                       |
| 900/914        | 20    | 152  |                  | 435   | 330   | 22   |      |      |     |                                        |                                                           |
| 1 060/1 067    | 20    | 150  |                  |       |       |      |      |      |     |                                        |                                                           |



Table 1 (continued)

| Grinding wheel        |                       |      | Hub flange            |                       |                       |          |          |          |          | Number and size of screws <sup>d</sup> |                                                           |
|-----------------------|-----------------------|------|-----------------------|-----------------------|-----------------------|----------|----------|----------|----------|----------------------------------------|-----------------------------------------------------------|
| <i>D</i> <sup>a</sup> | <i>T</i> <sup>a</sup> |      | <i>H</i> <sup>a</sup> | <i>D</i> <sub>F</sub> | <i>D</i> <sub>i</sub> | <i>B</i> | <i>N</i> | <i>S</i> | <i>Q</i> | <i>Z</i>                               | 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                   |                       |          |          |          |          |                                        |                                                           |

<sup>a</sup> 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.

<sup>b</sup> 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.

<sup>c</sup> Dimension *T* is the actual size of the grinding wheel thickness.

<sup>d</sup> 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.

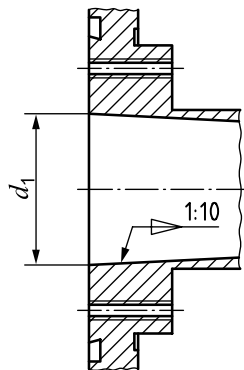


Figure 2 — Taper 1:10

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

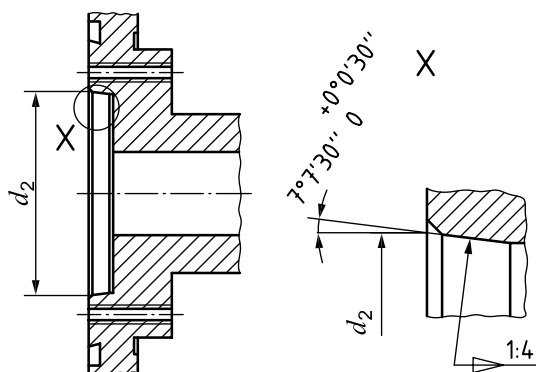


Figure 3 — Short taper 1:4 (female taper)

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

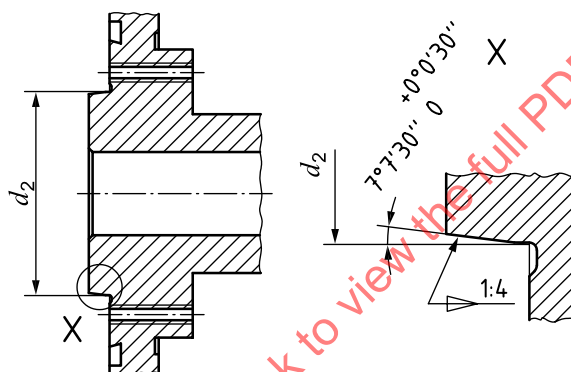


Figure 4 — Short taper 1:4 (male taper)

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

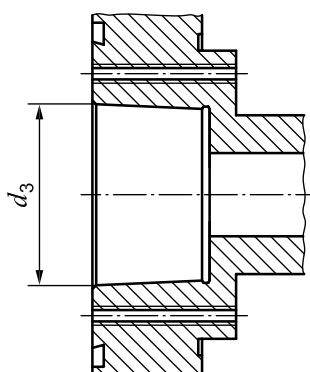


Figure 5 — Taper 1:10 (female taper)

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

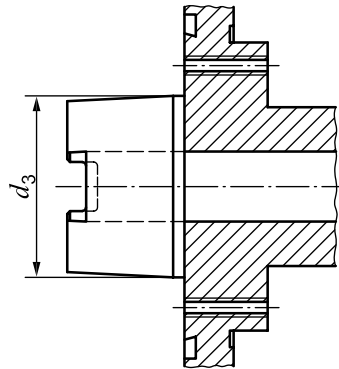


Figure 6 — Taper 1:9,98 (male taper)

#### 4.4 Material

The material is steel with a minimum tensile strength of 500 N/mm<sup>2</sup>; 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.

Table 2 — Connecting dimensions of flange sockets

| Grinding wheel |          | Flange socket                   |                                                       |                                                       |
|----------------|----------|---------------------------------|-------------------------------------------------------|-------------------------------------------------------|
| <i>D</i>       | <i>H</i> | Type A<br><i>d</i> <sub>1</sub> | Types BF and BM<br><i>d</i> <sub>2</sub> <sup>a</sup> | Types CF and CM<br><i>d</i> <sub>3</sub> <sup>b</sup> |
| 200            | 50,8     | 40                              | 53,975                                                | 48,01                                                 |
| 250            |          |                                 |                                                       |                                                       |
| 200            | 76,2     | 40 and 63                       | 53,975<br>and<br>63,513                               | 48,01<br>and<br>60,012                                |
| 250            |          |                                 |                                                       |                                                       |
| 300            |          |                                 |                                                       |                                                       |
| 350/356        |          |                                 |                                                       |                                                       |
| 250            | 127      |                                 |                                                       |                                                       |
| 300            |          |                                 |                                                       |                                                       |
| 350/356        |          |                                 |                                                       |                                                       |
| 400/406        |          |                                 |                                                       |                                                       |
| 450/457        |          |                                 |                                                       |                                                       |
| 500/508        |          |                                 |                                                       |                                                       |
| 600/610        |          |                                 |                                                       |                                                       |
| 250            | 152,4    |                                 |                                                       |                                                       |
| 300            |          |                                 |                                                       |                                                       |
| 350/356        |          |                                 |                                                       |                                                       |
| 400/406        |          |                                 |                                                       |                                                       |
| 450/457        |          |                                 |                                                       |                                                       |
| 500/508        | 160      |                                 |                                                       |                                                       |
| 350/356        |          |                                 |                                                       |                                                       |
| 400/406        |          |                                 |                                                       |                                                       |
| 450/457        |          |                                 |                                                       |                                                       |
| 500/508        | 203,2    |                                 |                                                       |                                                       |
| 400/406        |          |                                 |                                                       |                                                       |
| 450/457        |          |                                 |                                                       |                                                       |
| 500/508        |          |                                 |                                                       |                                                       |
| 600/610        |          |                                 |                                                       |                                                       |
| 750/762        | 304,8    |                                 |                                                       |                                                       |
| 500/508        |          |                                 |                                                       |                                                       |
| 600/610        |          |                                 |                                                       |                                                       |
| 750/762        |          |                                 |                                                       |                                                       |
| 800/813        |          |                                 |                                                       |                                                       |
| 900/914        | 406,4    |                                 |                                                       |                                                       |
| 1 060/1 067    |          |                                 |                                                       |                                                       |
| 900/914        |          |                                 |                                                       |                                                       |
| 1 060/1 067    | 508      |                                 |                                                       |                                                       |
| 1 060/1 067    |          |                                 |                                                       |                                                       |
| 1 250          |          |                                 |                                                       |                                                       |

<sup>a</sup> Complete dimensions in accordance with ISO 702-1.

<sup>b</sup> Complete dimensions in accordance with ISO 12164-1 and ISO 12164-2.

## 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.

## 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 <sup>2</sup>  |
| $A_s$      | stressed cross-section of the screws                                                               | mm <sup>2</sup>  |
| $D$        | 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 <sup>2</sup> |
| $K$        | coefficient for the calculation of the unbalance mass                                              | —                |
| $K_\alpha$ | tightening factor                                                                                  | —                |
| $K_\beta$  | correction value for the influence of the flange camber                                            | —                |
| $K_\gamma$ | correction factor for the influence of settlement effects                                          | —                |
| $K_\delta$ | 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              |

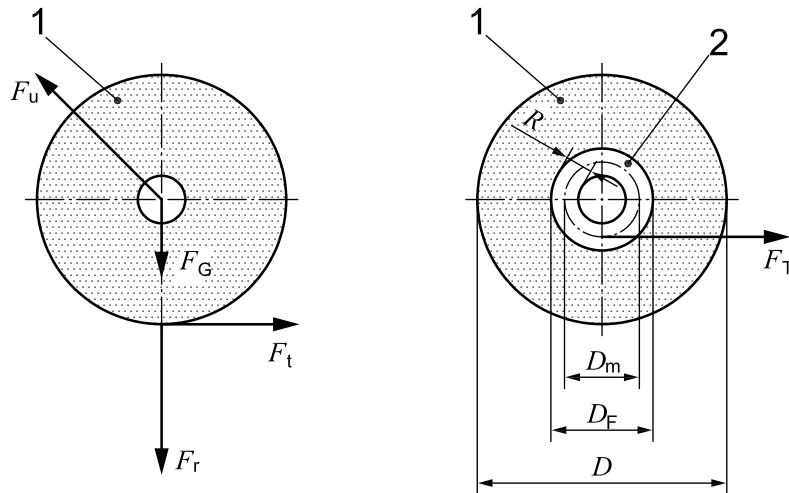
|            |                                                                                |                   |
|------------|--------------------------------------------------------------------------------|-------------------|
| $M_G$      | thread torque of a screw                                                       | 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 <sup>2</sup> |
| $R$        | clamping width                                                                 | mm                |
| $R_{p0,2}$ | 0,2 % proof stress                                                             | N/mm <sup>2</sup> |
| $r_K$      | 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 <sup>3</sup>   |
| $Z$        | number of clamping screws                                                      | —                 |
| $\alpha$   | helix angle of thread                                                          | °                 |
| $\mu_G$    | coefficient of friction of the thread                                          | —                 |
| $\mu_H$    | coefficient of friction between flange and grinding wheel                      | —                 |
| $\mu_K$    | coefficient of friction in the contact surface of the clamping screw           | —                 |
| $\rho_G$   | thread angle of friction                                                       | °                 |
| $\sigma_v$ | reduced stress                                                                 | N/mm <sup>2</sup> |
| $\sigma_z$ | tensile stress                                                                 | N/mm <sup>2</sup> |
| $\tau_t$   | torsional stress                                                               | N/mm <sup>2</sup> |

NOTE For  $K_\alpha$ ,  $K_\beta$ ,  $K_\gamma$ ,  $K_\delta$  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,  $F_t$ .



**Key**

- 1 grinding wheel
- 2 clamping area

**Figure A.1 — Operating forces**

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

$$F_G = M \cdot g \quad (\text{A.1})$$

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

$$F_u = 2 \cdot m \cdot \frac{v_s^2}{D} \quad (\text{A.2})$$

where

$$m = K \cdot \sqrt{M} \quad (\text{A.3})$$

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):

$$F_r = k_r \cdot F_t \quad (\text{A.4})$$

where

$$F_t = k_1 \cdot \frac{P_N}{v_s} \quad (\text{A.5})$$

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;