

# INTERNATIONAL STANDARD

**ISO**  
**4759-1**

Second edition  
2000-11-15

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## **Tolerances for fasteners —**

**Part 1:**

### **Bolts, screws, studs and nuts — Product grades A, B and C**

*Tolérances des éléments de fixation —*

*Partie 1: Vis, goujons et écrous — Grades A, B et C*



Reference number  
ISO 4759-1:2000(E)

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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 3.

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 part of ISO 4759 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4759-1 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 7, *Reference Standards for fasteners (mainly covering terminology, dimensioning, sizes and tolerancing)*.

This second edition cancels and replaces the first edition (ISO 4759-1:1978), which has been technically revised.

ISO 4759 consists of the following parts, under the general title *Tolerances for fasteners*:

- *Part 1: Bolts, screws, studs and nuts — Product grades A, B and C*
- *Part 3: Plain washers for bolts, screws and nuts — Product grades A and C*

Annexes A to C of this part of ISO 4759 are for information only.

# Tolerances for fasteners —

## Part 1:

## Bolts, screws, studs and nuts — Product grades A, B and C

### 1 Scope

This part of ISO 4759 specifies a selection of tolerances for bolts, screws, studs and nuts with ISO metric threads and with product grades A, B and C and for tapping screws with product grade A.

**NOTE** The product grades refer to the size of the tolerances where grade A is the most precise and grade C is the least precise.

The tolerances, except tolerances for threads, are selected from the system of limits and fits specified in ISO 286-1 and ISO 286-2. The tolerances for metric threads are taken from the series of tolerance classes specified in ISO 965-3. The tolerances for tapping screw threads are covered in ISO 1478.

The tolerances of form and position are specified and indicated in accordance with ISO 1101, ISO 8015 and ISO 2692.

The tolerances specified in this part of ISO 4759 apply to fasteners prior to coating unless otherwise specified. See also ISO 4042.

Deviations from the tolerances specified in this part of ISO 4759 are only permitted in product standards where there are valid technical reasons. In cases where there is a difference between the tolerance requirements in this part of ISO 4759 and the product standard, the product standard takes precedence.

It is recommended that these tolerances also be used for non-standard fasteners.

Dimensions and tolerances given in this part of ISO 4759 are in millimetres.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 4759. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 4759 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 225:1983, *Fasteners — Bolts, screws, studs and nuts — Symbols and designation of dimensions*.

ISO 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*.

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*.

ISO 885:2000, *General purpose bolts and screws — Metric series — Radii under the head*.

ISO 965-3:1998, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads*.

ISO 1101:2000, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*.

ISO 1478:1999, *Tapping screws thread*.

ISO 1479:1983, *Hexagon head tapping screws*.

ISO 2692:1988, *Technical drawings — Geometrical tolerancing — Maximum material principle*.

ISO 4032:1999, *Hexagon nuts, style 1 — Product grades A and B*.

ISO 4042:1999, *Fasteners — Electroplated coatings*.

ISO 4757:1983, *Cross recesses for screws*.

ISO 7053:1992, *Hexagon washer head tapping screws*.

ISO 7721:1983, *Countersunk head screws — Head configuration and gauging*.

ISO 8015:1985, *Technical drawings — Fundamental tolerancing principle*.

ISO 10509:1992, *Hexagon flange head tapping screws*.

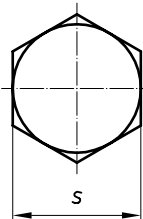
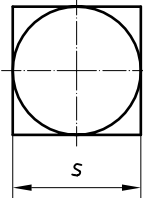
ISO 10642:1997, *Hexagon socket countersunk head screws*.

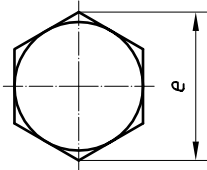
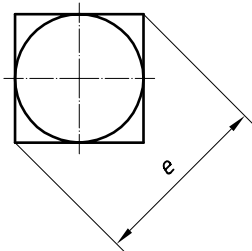
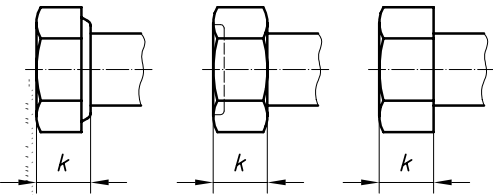
ISO 10664:1999, *Hexalobular internal driving feature for bolts and screws*.

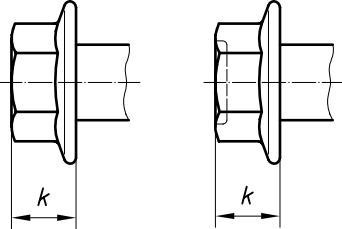
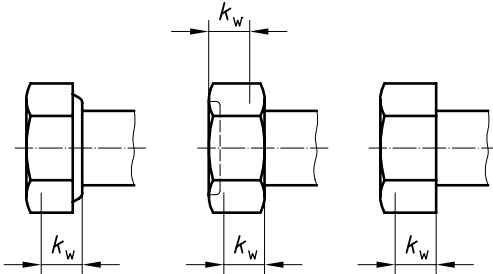
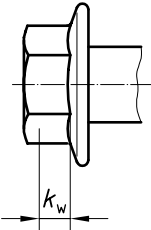
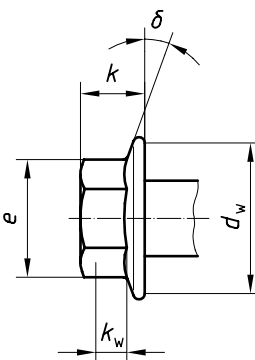
### 3 Tolerances for metric bolts, screws and studs

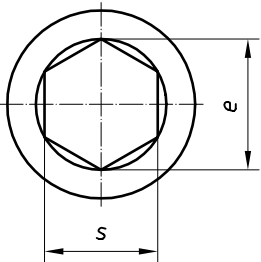
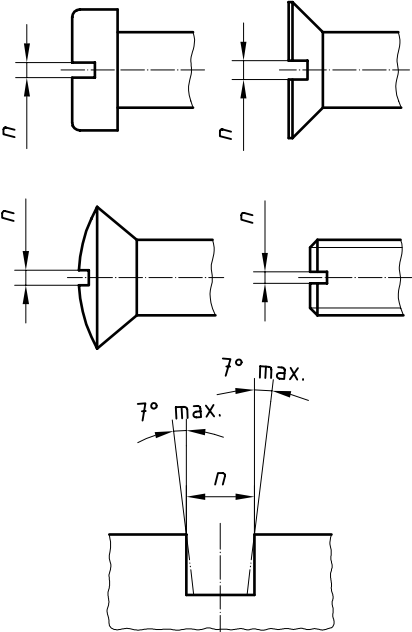
#### 3.1 Dimensional tolerances

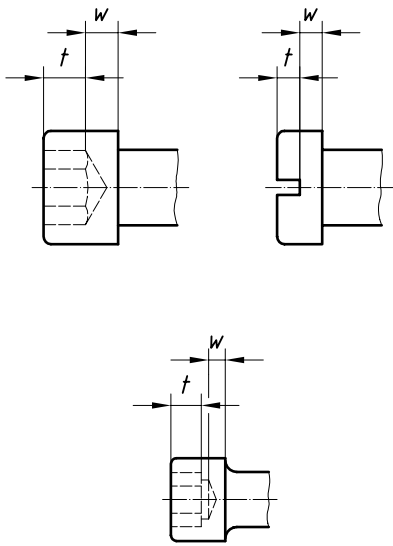
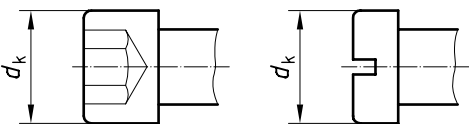
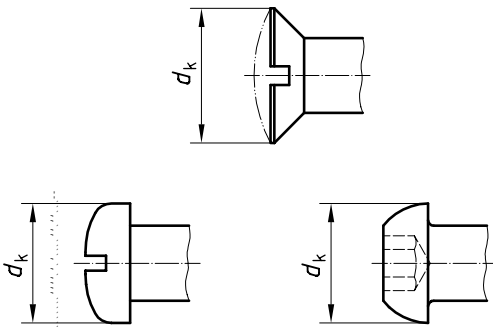
Symbols and designations of dimensions are specified in ISO 225.

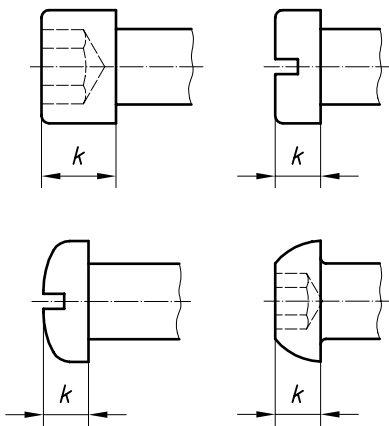
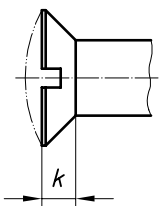
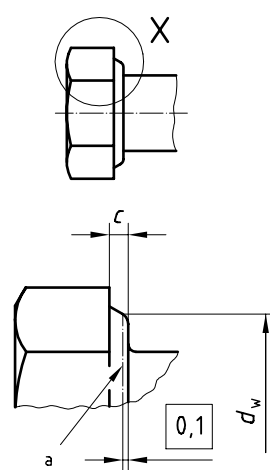
| Feature                                                                                                                                                                                                               | Tolerance for product grades |            |                                                  | Notes                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                       | A                            | B          | C                                                |                                                                                                                                        |
| <b>3.1.1 Tolerance level</b>                                                                                                                                                                                          |                              |            |                                                  |                                                                                                                                        |
| Shank and bearing surface                                                                                                                                                                                             | close                        | close      | wide                                             |                                                                                                                                        |
| Other features                                                                                                                                                                                                        | close                        | wide       | wide                                             |                                                                                                                                        |
| <b>3.1.2 External thread</b>                                                                                                                                                                                          | 6g                           | 6g         | 8g<br>(but 6g for property class 8.8 and higher) | For certain products and coatings, other tolerance classes for threads may be specified in the relevant product and coating standards. |
| <b>3.1.3 Driving features</b>                                                                                                                                                                                         |                              |            |                                                  |                                                                                                                                        |
| <b>3.1.3.1 External</b>                                                                                                                                                                                               | s                            | Tolerance  | s                                                | Tolerance                                                                                                                              |
| <b>3.1.3.1.1 Width across flats</b>                                                                                                                                                                                   | ≤ 30<br>> 30                 | h13<br>h14 | ≤ 18<br>> 18 ≤ 60<br>> 60 ≤ 180<br>> 180         | h14<br>h15<br>h16<br>h17                                                                                                               |
|  <p><b>Figure 1</b></p>  <p><b>Figure 2</b></p> |                              |            |                                                  |                                                                                                                                        |

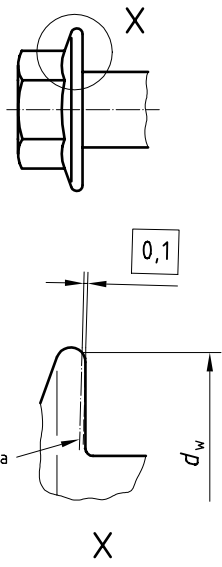
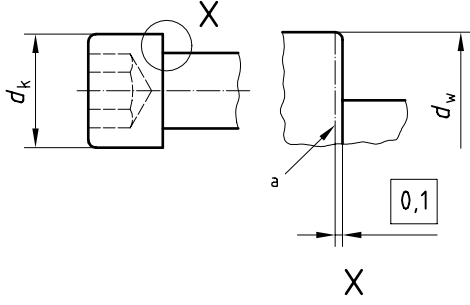
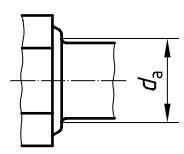
| Feature                                                                                                                                                    | Tolerance for product grades                                                                                                                                                              |      |                                                    | Notes                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------|-------------------------------------------|
|                                                                                                                                                            | A                                                                                                                                                                                         | B    | C                                                  |                                           |
| <div>3.1.3.1.2 Width across corners</div> <div></div> <div>Figure 3</div> | <div><math>e_{\min} = 1,13 s_{\min}</math></div> <div><math>e_{\min} = 1,12 s_{\min}</math> for bolts and screws with flange and other cold forged heads without trimming operation</div> |      |                                                    |                                           |
| <div></div> <div>Figure 4</div>                                           | <div><math>e_{\min} = 1,3 s_{\min}</math></div>                                                                                                                                           |      |                                                    |                                           |
| <div>3.1.3.1.3 Height of head</div> <div></div> <div>Figure 5</div>     | js14                                                                                                                                                                                      | js15 | <div><div><i>k</i></div><div>Tolerance</div></div> |                                           |
|                                                                                                                                                            |                                                                                                                                                                                           |      | <div><div>&lt; 10</div><div>≥ 10</div></div>       | <div><div>js16</div><div>js17</div></div> |

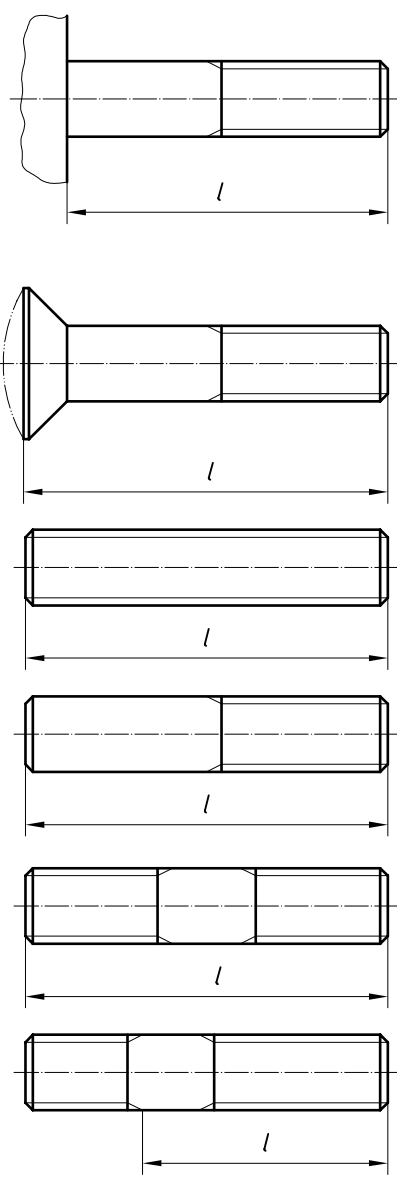
| Feature                                                                                                                                            | Tolerance for product grades                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   | Notes                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                    | A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | B | C |                                                                                                                                                                                                                                                                                                                                                                           |
|  <p><b>Figure 6</b></p>                                           | <p>For hexagon bolts and screws with flange, <math>k</math> is defined only as a maximum</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>3.1.3.1.4 Wrenching height</b></p>  <p><b>Figure 7</b></p> | $k_{w \min}^a = 0,7 k_{\min}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   | <p><math>k_w</math> defines the length over which <math>e_{\min}</math> applies but excluding any chamfer, washer face or radius specified in the appropriate product standard.</p> <p>The formulae for <math>k_{w \min}</math> only apply to the products illustrated.</p> <p><sup>a</sup> The symbol <math>k_w</math> replaces the previously used <math>k'</math>.</p> |
|  <p><b>Figure 8</b></p>                                         | $k_{w \min}^b = 0,7 \left[ (k_{\max} - IT15) - \left( x + \frac{d_{w \min} - e_{\min}}{2} \tan \delta_{\max} \right) \right]$ <p><math>x</math> is the greater of <math>c_{\min} \times 1,25</math> or <math>c_{\min} + 0,4</math></p> <p><math>\delta</math> is the flange angle</p> <p>Dimensions <math>k_w^a</math>, <math>k</math>, <math>d_w</math>, <math>e</math> and <math>\delta</math> are in accordance with ISO 225.</p>  <p><b>Figure 8 a)</b></p> |   |   | <p><sup>b</sup> For gauging, see annex A of the product standards</p>                                                                                                                                                                                                                                                                                                     |

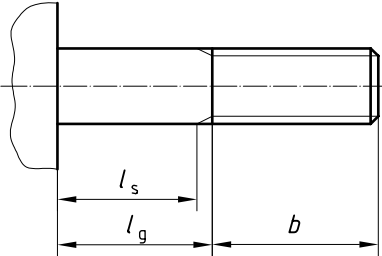
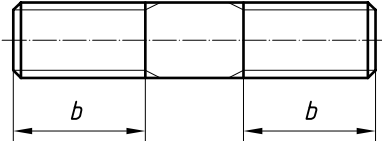
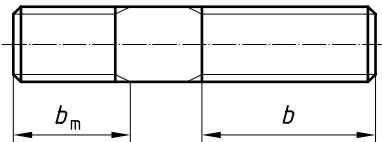
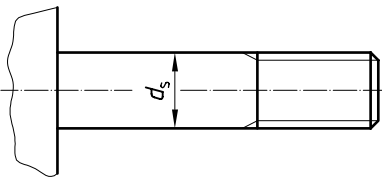
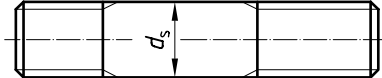
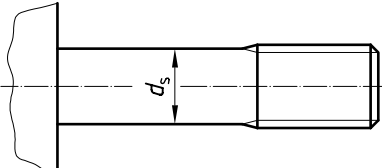
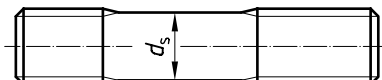
| Feature                                                                                                 | Tolerance for product grades |                  |   | Notes |                    |
|---------------------------------------------------------------------------------------------------------|------------------------------|------------------|---|-------|--------------------|
|                                                                                                         | A                            | B                | C |       |                    |
| 3.1.3.2 Internal                                                                                        |                              |                  |   |       |                    |
| 3.1.3.2.1 Hexagon sockets                                                                               |                              |                  |   |       |                    |
| <br><b>Figure 9</b>    | $e_{\min} = 1,14 s_{\min}$   |                  |   |       |                    |
|                                                                                                         | s                            | Tolerance        |   |       |                    |
|                                                                                                         | 0,7                          | EF8              |   |       |                    |
|                                                                                                         | 0,9                          | JS9              |   |       |                    |
|                                                                                                         | 1,3                          | K9               |   |       |                    |
|                                                                                                         | 1,5                          | D11              | — | —     |                    |
|                                                                                                         | 2                            |                  |   |       |                    |
|                                                                                                         | 2,5                          |                  |   |       |                    |
|                                                                                                         | 3                            |                  |   |       |                    |
|                                                                                                         | 4                            | E11              |   |       |                    |
|                                                                                                         | 5                            | E12              |   |       |                    |
|                                                                                                         | 6                            |                  |   |       |                    |
| 8                                                                                                       |                              |                  |   |       |                    |
| 10                                                                                                      |                              |                  |   |       |                    |
| 12                                                                                                      |                              |                  |   |       |                    |
| 14                                                                                                      |                              |                  |   |       |                    |
| > 14                                                                                                    | D12                          |                  |   |       |                    |
| 3.1.3.2.2 Slots                                                                                         |                              |                  |   |       |                    |
| <br><b>Figure 10</b> | n                            | Tolerance        |   |       | Tolerance field    |
|                                                                                                         | ≤ 1                          | + 0,20<br>+ 0,06 |   |       | C13 for $n \leq 1$ |
|                                                                                                         | > 1 ≤ 3                      | + 0,31<br>+ 0,06 |   |       | C14 for $n > 1$    |
|                                                                                                         | > 3 ≤ 6                      | + 0,37<br>+ 0,07 | — | —     |                    |

| Feature                                                                                                                                                          | Tolerance for product grades                                                                                                                     |   |   | Notes                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                  | A                                                                                                                                                | B | C |                                                                                                                |
| <b>3.1.3.2.3 Depth of hexagon sockets and slots</b>  <p>Figure 11</p>           | The depth of hexagon sockets and slots is specified in product standards only as a minimum. It is restricted by the minimum wall thickness $w$ . | — | — | For the time being generally applicable tolerances cannot be specified.                                        |
| <b>3.1.3.2.4 Cross recesses</b>                                                                                                                                  | See ISO 4757 for all dimensions except penetration depths. For penetration depths see appropriate product standard.                              |   |   |                                                                                                                |
| <b>3.1.3.2.5 Hexalobular recesses</b>                                                                                                                            | See ISO 10664 for all dimensions except penetration depths. For penetration depths see appropriate product standard.                             |   |   |                                                                                                                |
| <b>3.1.4 Other features</b><br><b>3.1.4.1 Head diameter</b>  <p>Figure 12</p> | $h13^a$                                                                                                                                          | — | — | $^a \pm IT13$ for knurled heads                                                                                |
|  <p>Figure 13</p>                                                             | $h14$                                                                                                                                            | — | — | Combined control of diameter and height for counter-sunk head screws in accordance with ISO 7721 or ISO 10642. |

| Feature                                                                                                                                                                                                                                                            | Tolerance for product grades                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      | Notes                                                                                                         |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------|----------|--|------|------|--------------|------|------|------------|------|------|----------|------|------|-----------|------|------|------------|------|------|------|------|-----|-----------------------------------------------------|
|                                                                                                                                                                                                                                                                    | A                                                                                                                                                                                                               | B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | C    |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
| <div>3.1.4.2 Head height<br/>(except for hexagon heads)</div> <div></div> <div>Figure 14</div>                                                                                    | <div>≤ M5: h13<br/>&gt; M5: h14</div>                                                                                                                                                                           | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | —    |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
| <div></div> <div>Figure 15</div>                                                                                                                                                 | For countersunk head screws <i>k</i> is defined in product standards only as a maximum.                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      | Combined control of diameter and height for countersunk head screws in accordance with ISO 7721 or ISO 10642. |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
| <div>3.1.4.3 Bearing face diameter and height of washer-faced portion</div> <div></div> <div>X</div> <div>a Reference datum for <i>d<sub>w</sub></i></div> <div>Figure 16</div> | <div><math>d_{w\min} = s_{\min} - IT16</math> for width across flats &lt; 21 mm<br/><math>d_{w\min} = 0,95\ s_{\min}</math> for width across flats ≥ 21 mm<br/><math>d_{w\max} = s_{\text{actual}}</math></div> | <div><table><tr><th rowspan="2">Thread diameter</th><th colspan="2"><i>c</i></th></tr><tr><th>min.</th><th>max.</th></tr><tr><td>≥ 1,6 to 2,5</td><td>0,10</td><td>0,25</td></tr><tr><td>&gt; 2,5 to 4</td><td>0,15</td><td>0,40</td></tr><tr><td>&gt; 4 to 6</td><td>0,15</td><td>0,50</td></tr><tr><td>&gt; 6 to 14</td><td>0,15</td><td>0,60</td></tr><tr><td>&gt; 14 to 36</td><td>0,20</td><td>0,80</td></tr><tr><td>&gt; 36</td><td>0,30</td><td>1,0</td></tr></table></div> |      | Thread diameter                                                                                               | <i>c</i> |  | min. | max. | ≥ 1,6 to 2,5 | 0,10 | 0,25 | > 2,5 to 4 | 0,15 | 0,40 | > 4 to 6 | 0,15 | 0,50 | > 6 to 14 | 0,15 | 0,60 | > 14 to 36 | 0,20 | 0,80 | > 36 | 0,30 | 1,0 | For product grade C a washer face is not mandatory. |
|                                                                                                                                                                                                                                                                    | Thread diameter                                                                                                                                                                                                 | <i>c</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
|                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                 | min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | max. |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
|                                                                                                                                                                                                                                                                    | ≥ 1,6 to 2,5                                                                                                                                                                                                    | 0,10                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0,25 |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
|                                                                                                                                                                                                                                                                    | > 2,5 to 4                                                                                                                                                                                                      | 0,15                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0,40 |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
|                                                                                                                                                                                                                                                                    | > 4 to 6                                                                                                                                                                                                        | 0,15                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0,50 |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
|                                                                                                                                                                                                                                                                    | > 6 to 14                                                                                                                                                                                                       | 0,15                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0,60 |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
| > 14 to 36                                                                                                                                                                                                                                                         | 0,20                                                                                                                                                                                                            | 0,80                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |
| > 36                                                                                                                                                                                                                                                               | 0,30                                                                                                                                                                                                            | 1,0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |                                                                                                               |          |  |      |      |              |      |      |            |      |      |          |      |      |           |      |      |            |      |      |      |      |     |                                                     |

| Feature                                                                                                                                                              | Tolerance for product grades                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |   | Notes                                                              |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---|--------------------------------------------------------------------|--|-------|---|--------|------|--|-----|--------------------------|-----|---|--------------------------|---|----|-------------------------|----|----|-------------------------|----|----|-------------------------|----|----|-----------------------|----|---|-------------------------|--------------------------|
|                                                                                                                                                                      | A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | B                        | C |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| <div></div> <p>a Reference datum for <math>d_w</math></p> <p><b>Figure 17</b></p>   | $d_w$ is defined in product standards only as a minimum.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                          |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| <div></div> <p>a Reference datum for <math>d_w</math></p> <p><b>Figure 18</b></p> | <table><tr><th colspan="2">Thread diameter</th><th><math>d_w</math></th></tr><tr><th>&gt;</th><th><math>\leq</math></th><th>min.</th></tr><tr><td></td><td>2,5</td><td><math>d_k \text{ min} - 0,14</math></td></tr><tr><td>2,5</td><td>5</td><td><math>d_k \text{ min} - 0,25</math></td></tr><tr><td>5</td><td>10</td><td><math>d_k \text{ min} - 0,4</math></td></tr><tr><td>10</td><td>16</td><td><math>d_k \text{ min} - 0,5</math></td></tr><tr><td>16</td><td>24</td><td><math>d_k \text{ min} - 0,8</math></td></tr><tr><td>24</td><td>36</td><td><math>d_k \text{ min} - 1</math></td></tr><tr><td>36</td><td>—</td><td><math>d_k \text{ min} - 1,2</math></td></tr></table> |                          |   | Thread diameter                                                    |  | $d_w$ | > | $\leq$ | min. |  | 2,5 | $d_k \text{ min} - 0,14$ | 2,5 | 5 | $d_k \text{ min} - 0,25$ | 5 | 10 | $d_k \text{ min} - 0,4$ | 10 | 16 | $d_k \text{ min} - 0,5$ | 16 | 24 | $d_k \text{ min} - 0,8$ | 24 | 36 | $d_k \text{ min} - 1$ | 36 | — | $d_k \text{ min} - 1,2$ | For product grade A only |
| Thread diameter                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | $d_w$                    |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| >                                                                                                                                                                    | $\leq$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | min.                     |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
|                                                                                                                                                                      | 2,5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $d_k \text{ min} - 0,14$ |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| 2,5                                                                                                                                                                  | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | $d_k \text{ min} - 0,25$ |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| 5                                                                                                                                                                    | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $d_k \text{ min} - 0,4$  |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| 10                                                                                                                                                                   | 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $d_k \text{ min} - 0,5$  |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| 16                                                                                                                                                                   | 24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $d_k \text{ min} - 0,8$  |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| 24                                                                                                                                                                   | 36                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | $d_k \text{ min} - 1$    |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| 36                                                                                                                                                                   | —                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | $d_k \text{ min} - 1,2$  |   |                                                                    |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |
| <div></div> <p><b>Figure 19</b></p>                                               | $d_a$ for products without undercut is specified in ISO 885.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                          |   | $d_a$ for undercut products, see the appropriate product standard. |  |       |   |        |      |  |     |                          |     |   |                          |   |    |                         |    |    |                         |    |    |                         |    |    |                       |    |   |                         |                          |

| Feature                                                                                                                                      | Tolerance for product grades |      |                                               | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------|-----------------------------------------------|-------|
|                                                                                                                                              | A                            | B    | C                                             |       |
| <div>3.1.4.4 Length</div> <div></div> <div>Figure 20</div> | js15                         | js17 | $l \leq 150$ : js17<br>$l > 150$ : $\pm IT17$ |       |

| Feature                                                                                                                                                                                                                                                                                                                                                                                                                   | Tolerance for product grades                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                              | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                           | A                                                                                                                                                                                                                                                            | B                                                                                                                                                                                                                                                            | C                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>3.1.4.5 Thread length</b><br><br><b>Bolt</b><br><br><br><b>Tie rod</b><br><br><br><b>Stud</b><br><br><br><b>Figure 21</b>                                         | $b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br><br><br><br><br><br><br><br><br><br>$b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br><br><br><br><br><br><br><br><br><br>$b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br>$b_m \text{ js16}$ | $b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br><br><br><br><br><br><br><br><br><br>$b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br><br><br><br><br><br><br><br><br><br>$b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br>$b_m \text{ js17}$ | $b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br><br><br><br><br><br><br><br><br><br>$b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br><br><br><br><br><br><br><br><br><br>$b \begin{smallmatrix} +2P \\ 0 \end{smallmatrix}$<br>$b_m \text{ js17}$ | <p><math>P</math> is the pitch of thread.</p> <p><math>l_s</math> is the minimum length of the unthreaded (plain) shank.</p> <p><math>l_g</math> is the maximum length of the unthreaded shank (thread run-out included) and is therefore the minimum clamping length.</p> <p>Tolerance <math>+ 2 P</math> related to dimension <math>b</math> applies only where <math>l_s</math> and <math>l_g</math> are not specified in the product standard.</p> <p><math>b_m</math> refers to metal end of studs only.</p> |
| <b>3.1.4.6 Shank diameter</b><br><br><br><br><br><br><br><br><b>Figure 22</b> | <h13< h1=""><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/> </h13<>                                                                                                                                                                                       | <h14< h1=""><br/><br/><br/><br/><br/><br/><br/><br/><br/><br/> </h14<>                                                                                                                                                                                       | $\pm \text{IT } 15$<br><br><br><br><br><br><br><br><br><br>                                                                                                                                                                                                  | <p>The tolerance is not applicable in the areas of the underhead fillet and thread run-out.</p>                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                           | Reduced shank diameter $\approx$ pitch diameter                                                                                                                                                                                                              |                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

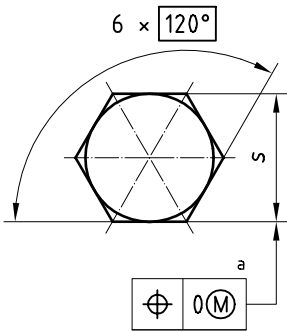
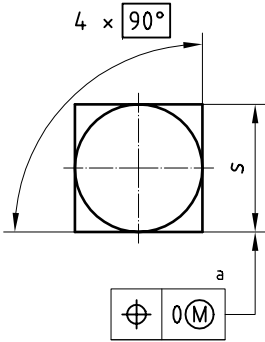
3.2 Geometrical tolerances

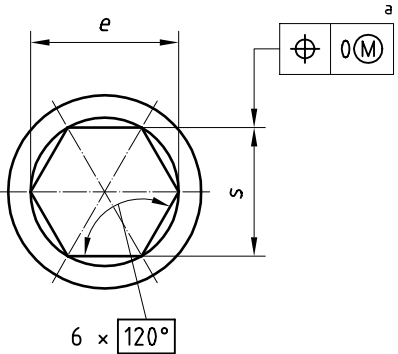
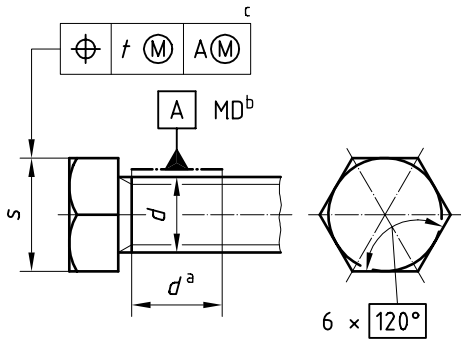
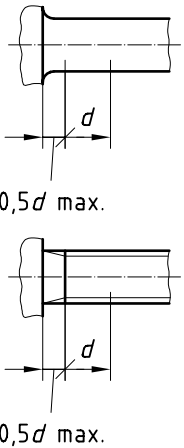
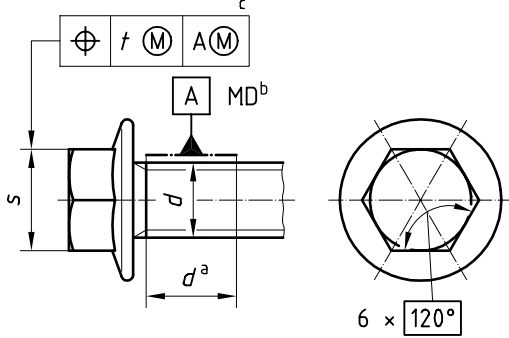
In accordance with ISO 1101 and ISO 2692 the tolerances specified in Figures 23 to 57 do not necessarily imply the use of any particular method of production, measurement or gauging.

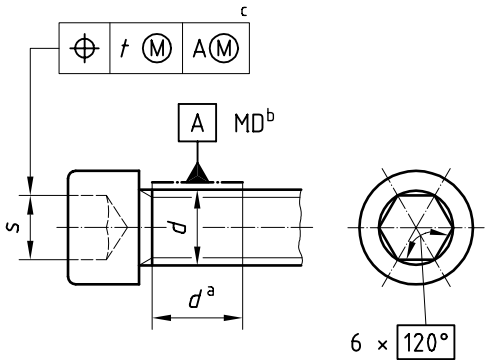
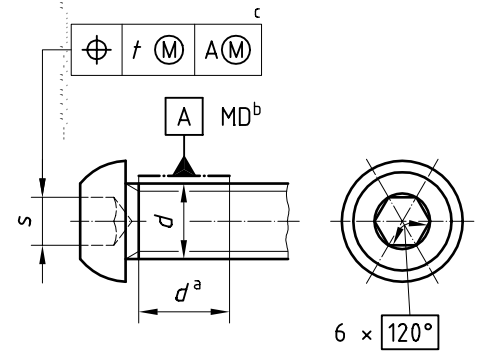
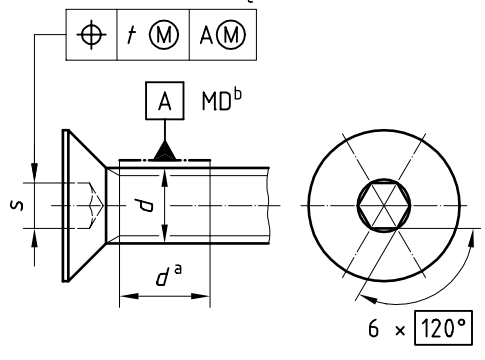
When the pitch diameter axis is specified as the datum and the coaxiality deviation of the major diameter axis relative to the pitch diameter axis is negligible, e.g. normally with rolled threads, the major diameter axis may be taken as the datum.

According to ISO 1101 when the datum is the thread axis the letters MD indicate that the datum reference is the major diameter axis.

The maximum material principle in accordance with ISO 2692 is used.

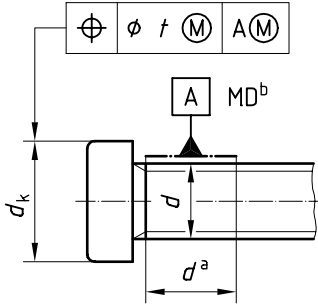
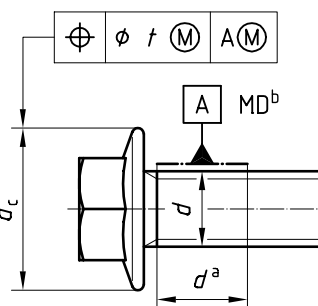
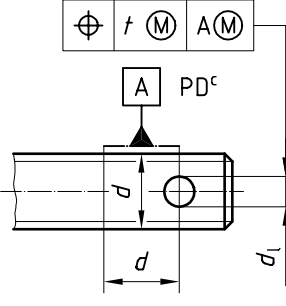
| Feature                                                                                                                                                                                                                                                                                                                                                                                                   | Tolerance <i>t</i> for product grades |   |   | Notes |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|---|-------|
|                                                                                                                                                                                                                                                                                                                                                                                                           | A                                     | B | C |       |
| <div>3.2.1 Driving feature</div> <div>3.2.1.1 Tolerances of form</div> <div>3.2.1.1.1 External</div> <div></div> <div>3 × simultaneously.</div> <div>Figure 23</div> <div></div> <div>2 × simultaneously.</div> <div>Figure 24</div> |                                       |   |   |       |

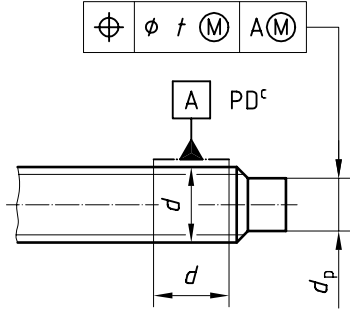
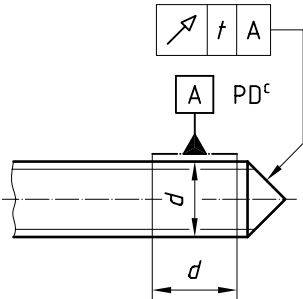
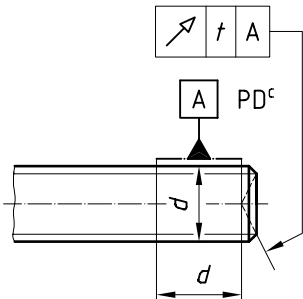
| Feature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Tolerance $t$ for product grades |        |        | Tolerance $t$ based on dimensions | Notes                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------|--------|-----------------------------------|--------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A                                | B      | C      |                                   |                                                                                      |
| <b>3.2.1.1.2 Internal</b><br> <p><sup>a</sup> 3 × simultaneously.</p> <p><b>Figure 25</b></p>                                                                                                                                                                                                                                                                                                                                                                                   |                                  |        |        |                                   |                                                                                      |
| <b>3.2.1.2 Tolerances of position</b><br> <p><sup>a</sup> The datum A shall be as close to the head as possible but within 0,5d distance of the head and shall be either wholly plain or wholly threaded but shall not include the thread run-out or underhead fillet.</p> <p><sup>b</sup> MD means that tolerance applies in relation to the axis of the cylinder derived from the major thread diameter.</p> <p><sup>c</sup> 3 × simultaneously.</p> <p><b>Figure 26</b></p> | 2 IT13                           | 2 IT14 | 2 IT15 | s                                 |  |
|  <p>a, b, c See Figure 26.</p> <p><b>Figure 27</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                        | 2 IT13                           | 2 IT14 | —      | s                                 |                                                                                      |

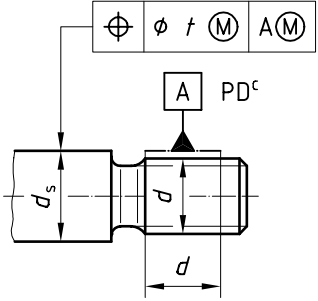
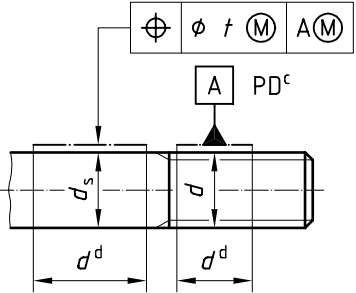
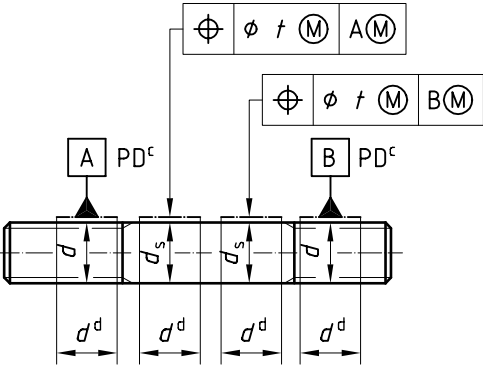
| Feature                                                                                                                                            | Tolerance <i>t</i> for product grades |   |   | Tolerance <i>t</i> based on dimensions | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|---|----------------------------------------|-------|
|                                                                                                                                                    | A                                     | B | C |                                        |       |
| <div><p>a, b, c See Figure 26</p><p><b>Figure 28</b></p></div>    | 2 IT13                                | — | — | <i>d</i>                               |       |
| <div><p>a, b, c See Figure 26.</p><p><b>Figure 29</b></p></div>  | 2 IT13                                | — | — | <i>d</i>                               |       |
| <div><p>a, b, c See Figure 26.</p><p><b>Figure 30</b></p></div> | 2 IT13                                | — | — | <i>d</i>                               |       |

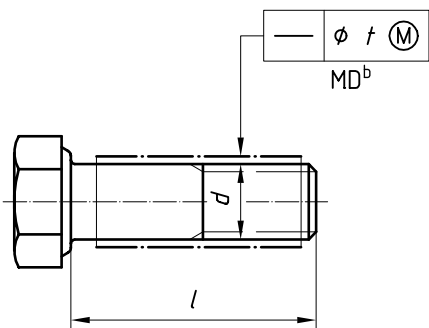
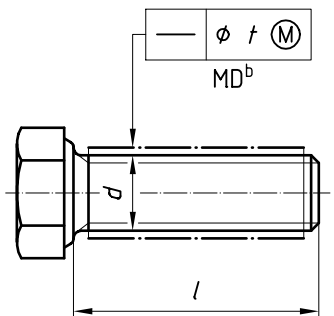
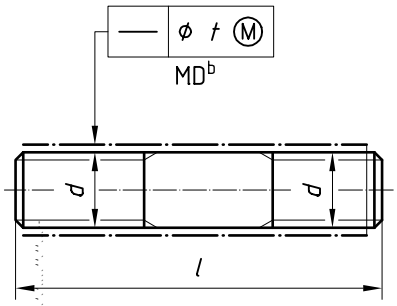
| Feature                                            | Tolerance $t$ for product grades |        |        | Tolerance $t$ based on dimensions | Notes |
|----------------------------------------------------|----------------------------------|--------|--------|-----------------------------------|-------|
|                                                    | A                                | B      | C      |                                   |       |
| <p>b, c See Figure 26.</p> <p><b>Figure 31</b></p> | 2 IT12                           | —      | —      | $d$                               |       |
| <p>a, b See Figure 26</p> <p><b>Figure 32</b></p>  | 2 IT12                           | 2 IT13 | 2 IT14 | $d$                               |       |
| <p>a, b See Figure 26.</p> <p><b>Figure 33</b></p> | 2 IT12                           | 2 IT13 | 2 IT14 | $d$                               |       |
| <p>a, b See Figure 26.</p> <p><b>Figure 34</b></p> | 2 IT12                           | 2 IT13 | 2 IT14 | $d$                               |       |

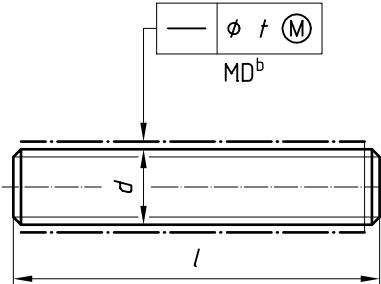
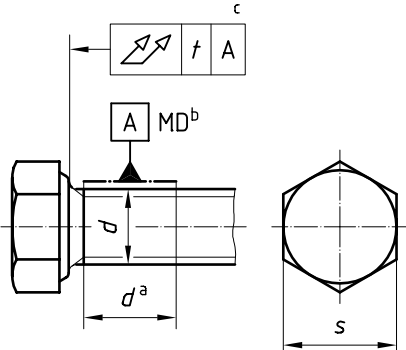
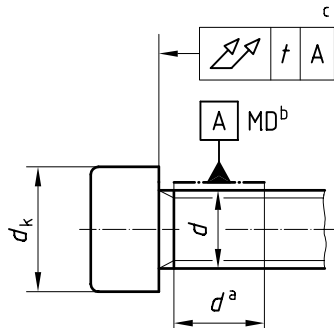
| Feature                                                                                                                                                                                                      | Tolerance <i>t</i> for product grades |   |   | Tolerance <i>t</i> based on dimensions | Notes |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|---|----------------------------------------|-------|
|                                                                                                                                                                                                              | A                                     | B | C |                                        |       |
| <div></div> <p>b See Figure 26.</p> <p><b>Figure 35</b></p>                                                                                                                                                  | 2 IT12                                | — | — | <i>d</i>                               |       |
| <div></div> <p>a, b See Figure 26.</p> <p>c For referee purposes coaxiality of cross recess shall be assessed by means of a penetration gauge point in accordance with ISO 4757.</p> <p><b>Figure 36</b></p> | 2 IT13                                | — | — | <i>d</i>                               |       |
| <div></div> <p>a, b See Figure 26.</p> <p>c See Figure 36.</p> <p><b>Figure 37</b></p>                                                                                                                       | 2 IT13                                | — | — | <i>d</i>                               |       |

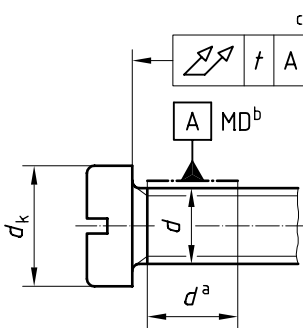
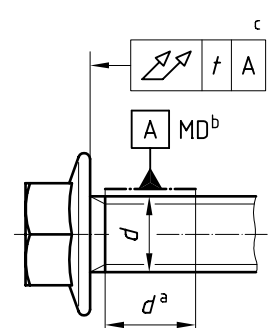
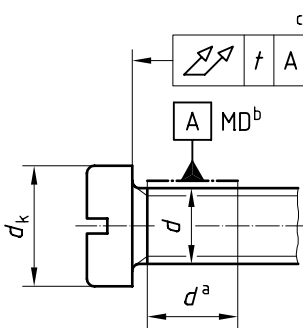
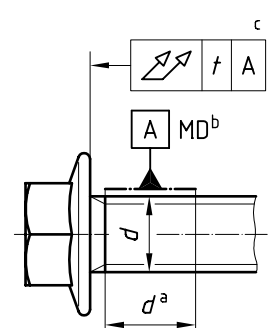
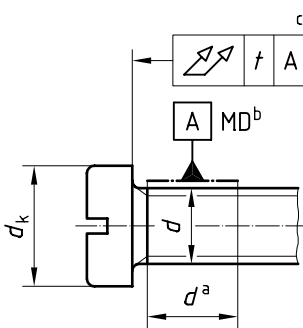
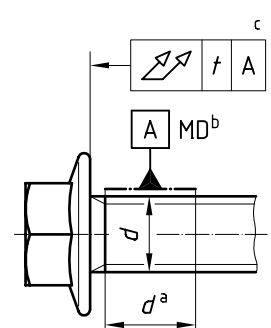
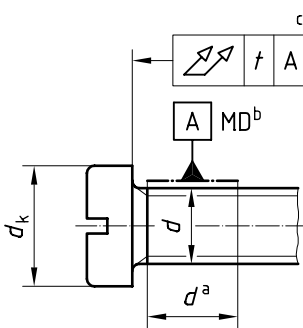
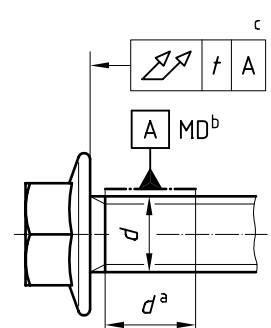
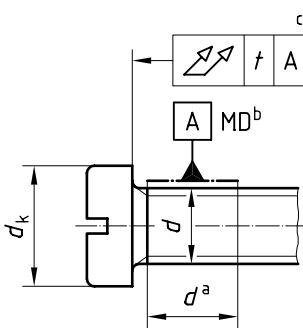
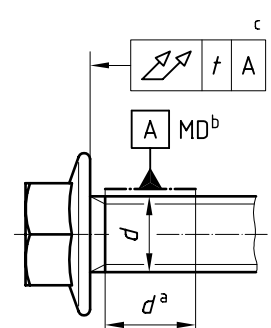
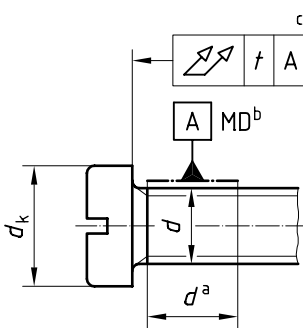
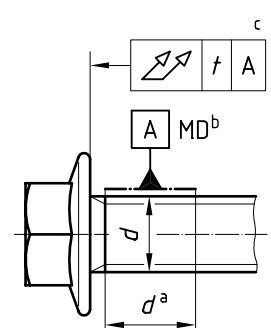
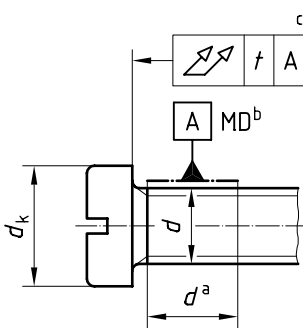
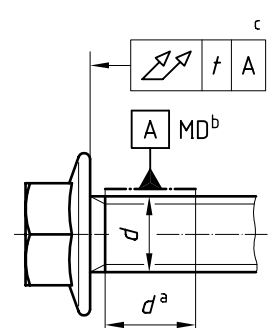
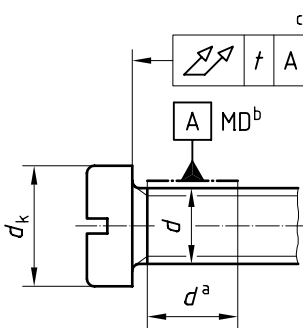
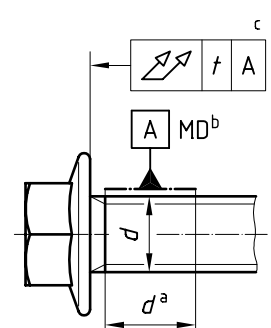
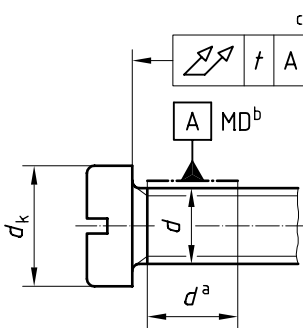
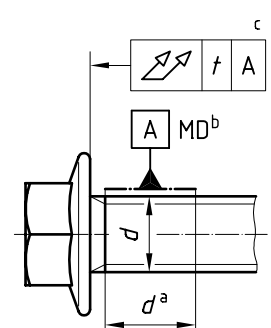
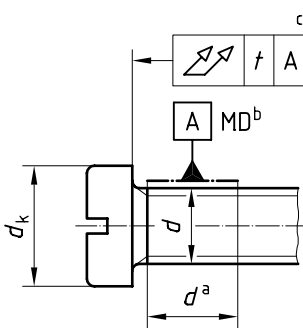
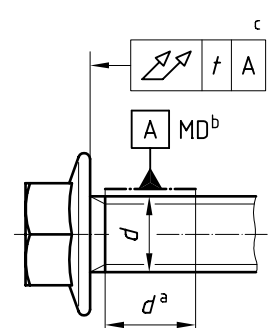
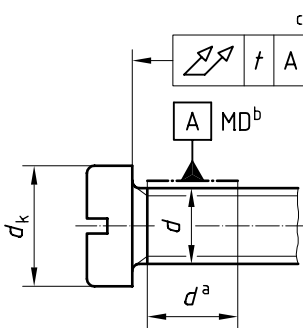
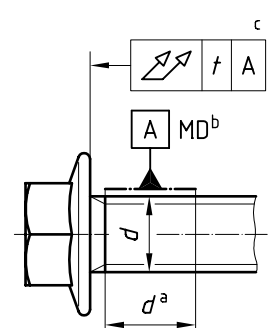
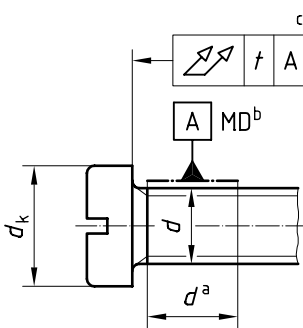
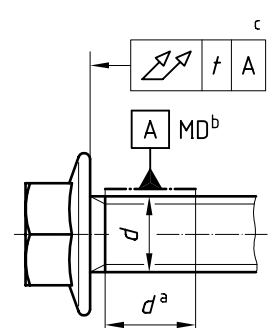
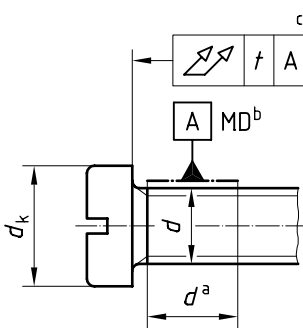
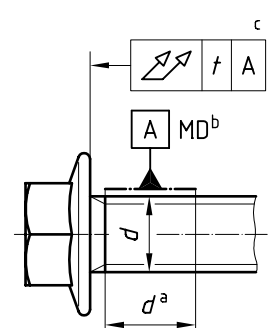
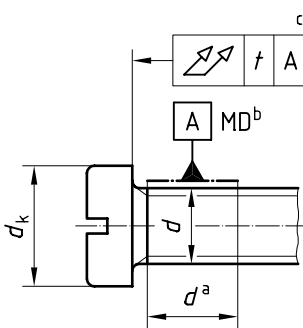
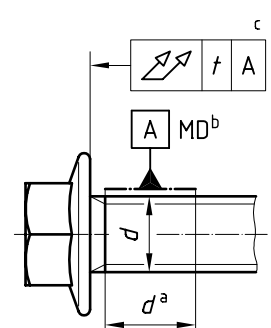
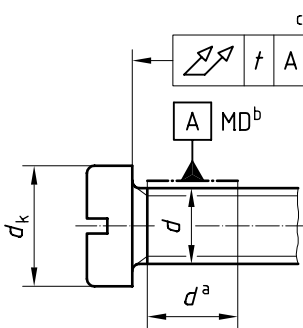
| Feature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Tolerance $t$ for product grades |        |        | Tolerance $t$ based on dimensions | Notes |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------|--------|-----------------------------------|-------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A                                | B      | C      |                                   |       |
| <b>3.2.2 Other features</b><br><br><b>3.2.2.1 Tolerances of position and run-out</b><br><br> <p>a, b See Figure 26.</p> <p><b>Figure 38</b></p>  <p>a, b See Figure 26.</p> <p><b>Figure 39</b></p>  <p><sup>c</sup> PD means that the tolerance applies in relation to the axis derived from the pitch diameter.</p> <p><b>Figure 40</b></p> | 2 IT13                           | 2 IT14 | 2 IT15 | $d_k$                             |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 IT13                           | 2 IT14 | —      | $d_c$                             |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 IT13                           | 2 IT14 | 2 IT15 | $d$                               |       |

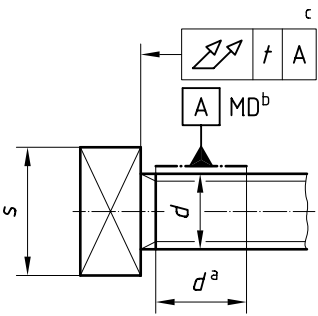
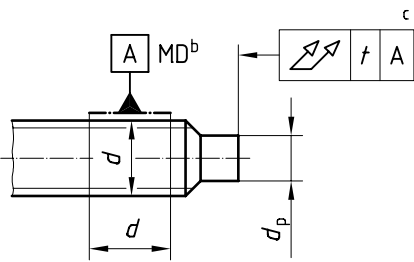
| Feature                                                                                                                                                   | Tolerance <i>t</i> for product grades    |   |   | Tolerance <i>t</i> based on dimensions | Notes                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---|---|----------------------------------------|----------------------------------------------------------------------|
|                                                                                                                                                           | A                                        | B | C |                                        |                                                                      |
| <div></div> <p><sup>c</sup> See Figure 40.</p> <p><b>Figure 41</b></p>   | IT13 <sup>d</sup><br>2 IT13 <sup>e</sup> | — | — | <i>d</i>                               | <sup>d</sup> For set screws.<br><sup>e</sup> For all other products. |
| <div></div> <p><sup>c</sup> See Figure 40.</p> <p><b>Figure 42</b></p>  | IT13                                     | — | — | <i>d</i>                               |                                                                      |
| <div></div> <p><sup>c</sup> See Figure 40.</p> <p><b>Figure 43</b></p> | IT13                                     | — | — | <i>d</i>                               |                                                                      |

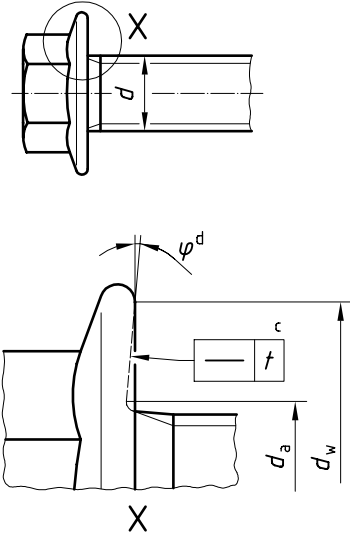
| Feature                                                                                                                                                                                                                                                                             | Tolerance $t$ for product grades |        |        | Tolerance $t$ based on dimensions | Notes |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------|--------|-----------------------------------|-------|
|                                                                                                                                                                                                                                                                                     | A                                | B      | C      |                                   |       |
|  <p>c See Figure 40.</p> <p><b>Figure 44</b></p>                                                                                                                                                   | 2 IT13                           | 2 IT14 | 2 IT15 | $d$                               |       |
|  <p>c See Figure 40.</p> <p>d The gauge datum feature A shall be as close to the respective part of the shank as possible but shall avoid the thread run-out.</p>                                 | IT13                             | IT14   | IT15   | $d$                               |       |
|  <p>c See Figure 40.</p> <p>d The gauge datum features A and B shall be as close to the respective part of the shank as possible but shall avoid the thread run-out.</p> <p><b>Figure 46</b></p> | IT13                             | IT14   | —      | $d$                               |       |

| Feature                                                                                                                                                                                                                                                                                                                                                                                                                          | Tolerance $t$ for product grades |   |   | Tolerance $t$ based on dimensions | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---|---|-----------------------------------|-------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                  | A                                | B | C |                                   |       |
| <b>3.2.2.2 Tolerances of straightness</b><br> <p><math>d</math></p> <p><math>\leq 8</math> <math>t = 0,002l + 0,05</math></p> <p><math>&gt; 8</math> <math>t = 0,002\ 5l + 0,05</math></p> <p><math>d \leq 8: t = 2(0,002l + 0,05)</math><br/> <math>d &gt; 8: t = 2(0,002\ 5l + 0,05)</math></p> <p>b See Figure 26.<br/> <b>Figure 47</b></p> |                                  |   |   |                                   |       |
|  <p><math>d</math></p> <p><math>\leq 8</math> <math>t = 0,002l + 0,05</math></p> <p><math>&gt; 8</math> <math>t = 0,002\ 5l + 0,05</math></p> <p><math>d \leq 8: t = 2(0,002l + 0,05)</math><br/> <math>d &gt; 8: t = 2(0,002\ 5l + 0,05)</math></p> <p>b See Figure 26.<br/> <b>Figure 48</b></p>                                             |                                  |   |   |                                   |       |
|  <p><math>d</math></p> <p><math>\leq 8</math> <math>t = 0,002l + 0,05</math></p> <p><math>&gt; 8</math> <math>t = 0,002\ 5l + 0,05</math></p> <p>—</p> <p>b See Figure 26.<br/> <b>Figure 49</b></p>                                                                                                                                          |                                  |   |   |                                   |       |

| Feature                                                                                                                                                                                                                                                                                                                                                                                                             | Tolerance $t$ for product grades |      |                                                                    | Tolerance $t$ based on dimension $d$ | Notes                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------|--------------------------------------------------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                     | A                                | B    | C                                                                  |                                      |                                                                                                                                                                                                                                                                                                                        |
|  <p>b See Figure 26.</p> <p><b>Figure 50</b></p>                                                                                                                                                                                                                                                                                   |                                  |      | $d \leq 8: t = 2(0,002l + 0,05)$<br>$d > 8: t = 2(0,0025l + 0,05)$ |                                      |                                                                                                                                                                                                                                                                                                                        |
| <p><b>3.2.2.3 Tolerance of total run-out</b></p>  <p>a, b See Figure 26.</p> <p>c Up to 0,8s diameter only.</p> <p><b>Figure 51</b></p>  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 52</b></p> | 0,04                             |      |                                                                    | 1,6                                  | <p>For product grades A and B tolerance <math>t</math> is calculated as follows:</p> <p><math>\leq M 39:</math><br/> <math>t = 1,2 d \cdot \tan 1^\circ</math><br/> <math>&gt; M 39:</math><br/> <math>t = 1,2 d \cdot \tan 0,5^\circ</math></p> <p>For product grade C tolerance <math>t</math> is twice as much.</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,08                             |      |                                                                    | 2                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |      |                                                                    | 2,5                                  |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |      |                                                                    | 3                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |      |                                                                    | 3,5                                  |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |      |                                                                    | 4                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,15                             | 0,3  |                                                                    | 5                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |      |                                                                    | 6                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |      |                                                                    | 7                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,17                             | 0,34 |                                                                    | 8                                    |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,21                             | 0,42 |                                                                    | 10                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,25                             | 0,50 |                                                                    | 12                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,29                             | 0,58 |                                                                    | 14                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,34                             | 0,68 |                                                                    | 16                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,38                             | 0,76 |                                                                    | 18                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,42                             | 0,84 |                                                                    | 20                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,46                             | 0,92 |                                                                    | 22                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,50                             | 1,00 |                                                                    | 24                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,57                             | 1,14 |                                                                    | 27                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,63                             | 1,26 |                                                                    | 30                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,69                             | 1,38 |                                                                    | 33                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,76                             | 1,52 |                                                                    | 36                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,82                             | 1,64 |                                                                    | 39                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,44                             | 0,88 |                                                                    | 42                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,47                             | 0,94 |                                                                    | 45                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,50                             | 1    |                                                                    | 48                                   |                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,55                             | 1,1  |                                                                    | 52                                   |                                                                                                                                                                                                                                                                                                                        |

| Feature                                                                                                                                                                                   | Tolerance $t$ for product grades |      |     | Tolerance $t$ based on dimension $d$ | Notes |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------|-----|--------------------------------------|-------|
|                                                                                                                                                                                           | A                                | B    | C   |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,04                             | —    | 1,6 |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,08                             | 0,3  | 2,5 |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,15                             | 0,34 | 3   |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,17                             | 0,42 | 4   |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,21                             | 0,50 | 5   |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,25                             | 0,58 | 6   |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,29                             | 0,68 | 7   |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,34                             | 0,76 | 8   |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,38                             | 0,84 | 10  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,42                             | 0,92 | 12  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,46                             | 1,00 | 14  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,50                             | 1,14 | 16  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,57                             | 1,26 | 18  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,63                             | 1,38 | 20  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,69                             | 1,52 | 22  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,76                             | 1,64 | 24  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,82                             | 0,88 | 27  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,44                             | 0,94 | 30  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,47                             | 1    | 33  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,50                             | 1,1  | 36  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,55                             | —    | 39  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,44                             | 0,88 | 42  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,47                             | 0,94 | 45  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,50                             | 1    | 48  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,55                             | —    | 52  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,44                             | 0,88 | 42  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,47                             | 0,94 | 45  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Line of highest points on any radial line.</p> <p><b>Figure 54</b></p> | 0,50                             | 1    | 48  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |
|  <p>a, b See Figure 26.</p> <p>c Up to 0,8 <math>d_k</math> diameter only.</p> <p><b>Figure 53</b></p>   | 0,55                             | —    | 52  |                                      |       |
|                                                                                                                                                                                           |                                  |      |     |                                      |       |

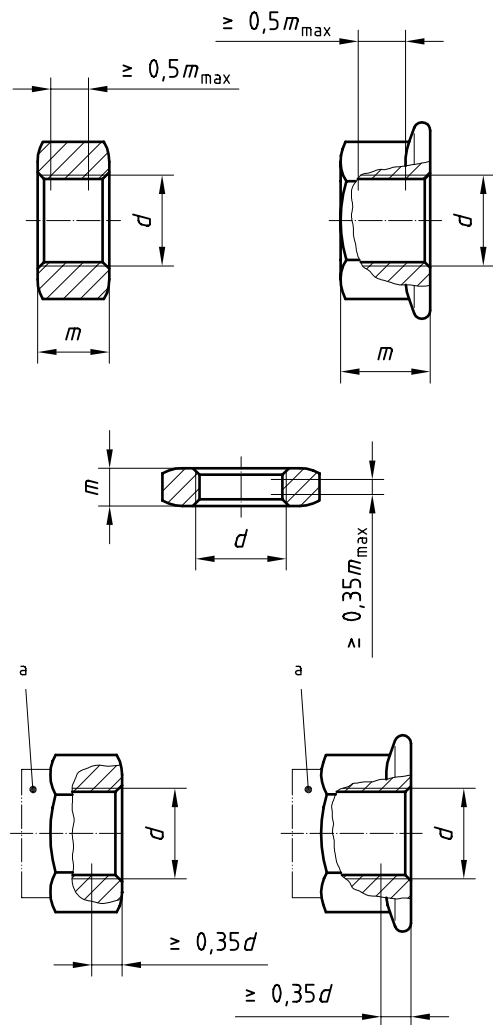
| Feature                                                                                                                                                                                | Tolerance $t$ for product grades |   |   | Tolerance $t$ based on dimensions  | Notes                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---|---|------------------------------------|-------------------------------------------|
|                                                                                                                                                                                        | A                                | B | C |                                    |                                           |
|  <p>a, b See Figure 26.<br/>c See Figure 51.</p> <p><b>Figure 55</b></p>                              | For $t$ see Figures 51 to 54     |   |   | Basis for $t$ see Figures 51 to 54 | For dog points only, not for pilot points |
|  <p>a, b See Figure 26.<br/>c Up to <math>\varnothing 0,8d_p</math> only</p> <p><b>Figure 56</b></p> |                                  |   |   |                                    |                                           |

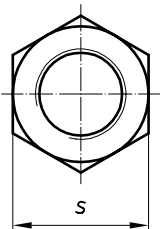
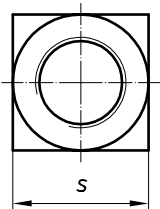
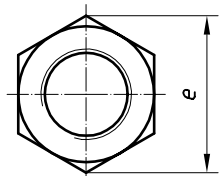
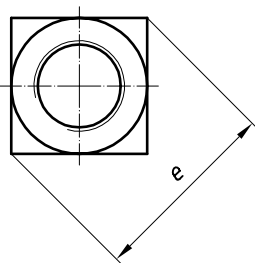
| Feature                                                                                                                                                                                  | Tolerance <i>t</i> for product grades |   |   | Tolerance <i>t</i> based on dimensions | Notes |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|---|----------------------------------------|-------|
|                                                                                                                                                                                          | A                                     | B | C |                                        |       |
| <div>3.2.2.4 Permissible deviation from the form of bearing face</div> <div></div> <div>Figure 57</div> | 0,005 <i>d</i>                        |   |   | <i>d</i>                               |       |

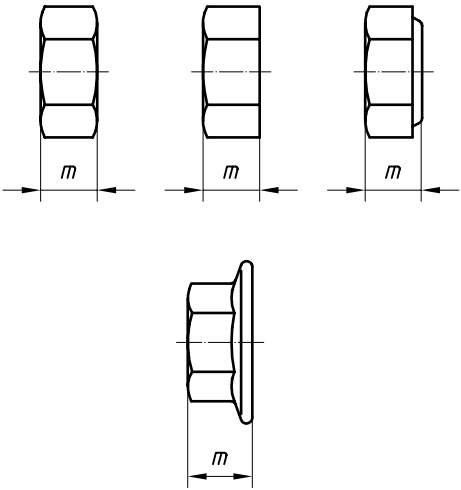
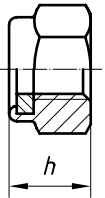
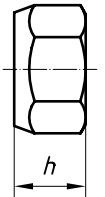
## 4 Tolerances for metric nuts

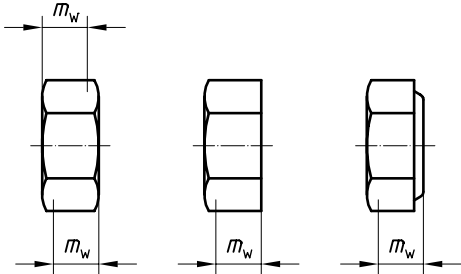
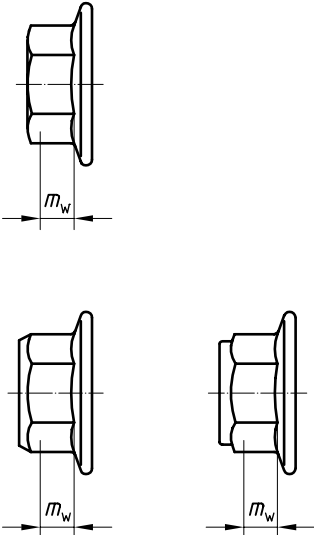
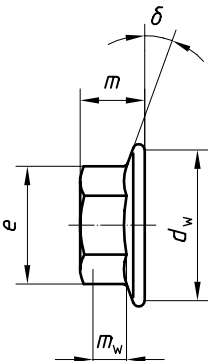
### 4.1 Dimensional tolerances

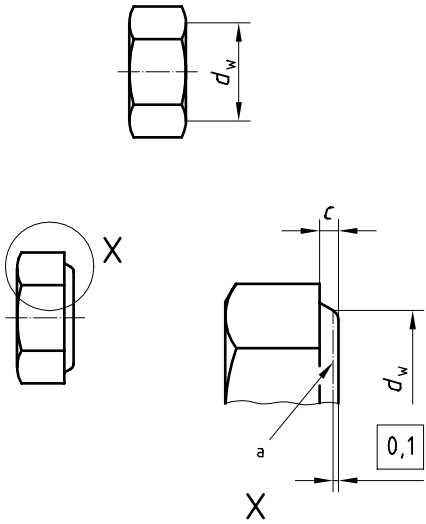
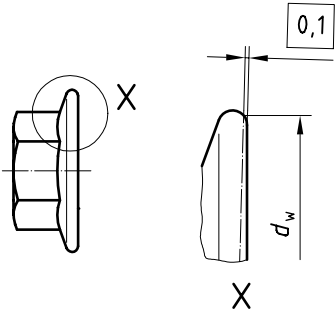
NOTE Symbols and designations of dimensions are specified in ISO 225.

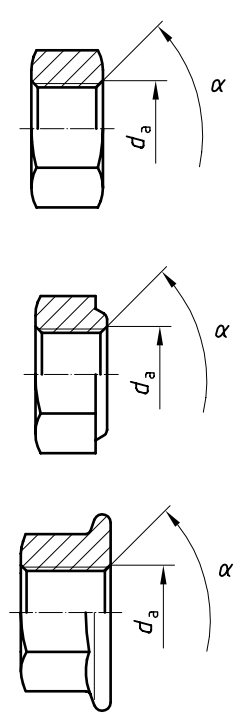
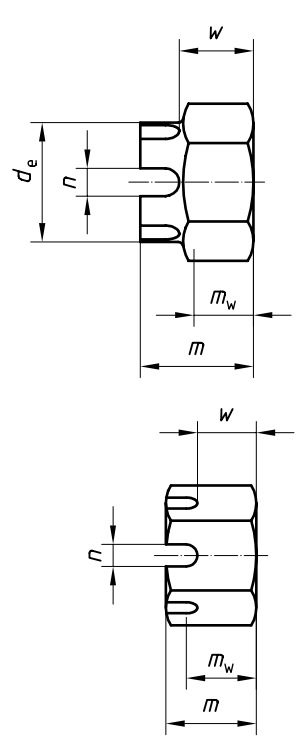
| Feature                                                                                                                                                                                                                | Tolerance for product grades |       |      | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                        | A                            | B     | C    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>4.1.1 Tolerance level</b><br>Bearing surface<br>Other features                                                                                                                                                      | close                        | close | wide |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>4.1.2 Internal thread</b><br> <p>a Profile varies for different types of prevailing torque type nuts.</p> <p><b>Figure 58</b></p> | 6H                           | 6H    | 7H   | For certain products and coatings, other tolerance classes may be specified in the relevant product and coating standards.<br><br>For all nuts of heights $m \geq 0,8d$ the minor diameter shall be within the specified tolerances for a minimum of $0,5 m_{\max}$ (only for sizes $\geq M3$ ).<br><br>For all nuts of heights $0,5d \leq m < 0,8d$ the minor diameter shall be within the specified tolerances for a minimum of $0,35 m_{\max}$<br><br>For prevailing torque type nuts the minor diameter may exceed the specified tolerance for a maximum height of $0,35d$ from the non-restricted end which does not contain the prevailing torque feature. |

| Feature                                                                                                 | Tolerance for product grades |            |                                          |                          | Notes |
|---------------------------------------------------------------------------------------------------------|------------------------------|------------|------------------------------------------|--------------------------|-------|
|                                                                                                         | A                            |            | B                                        | C                        |       |
| 4.1.3 Driving features                                                                                  |                              |            |                                          |                          |       |
| 4.1.3.1 Width across flats                                                                              |                              |            |                                          |                          |       |
| <br><b>Figure 59</b>   | s                            | Tolerance  | s                                        | Tolerance                |       |
|                                                                                                         | ≤ 30<br>> 30                 | h13<br>h14 | ≤ 18<br>> 18 ≤ 60<br>> 60 ≤ 180<br>> 180 | h14<br>h15<br>h16<br>h17 |       |
| <br><b>Figure 60</b>  | See figure 59                |            | See figure 59                            |                          |       |
| 4.1.3.2 Width across corners                                                                            |                              |            |                                          |                          |       |
| <br><b>Figure 61</b> | $e_{\min} = 1,13 s_{\min}$   |            |                                          |                          |       |
| <br><b>Figure 62</b> | $e_{\min} = 1,3 s_{\min}$    |            |                                          |                          |       |

| Feature                                                                                                                                                                                                                                                                                                           | Tolerance for product grades                                                                              |   |   | Notes                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---|---|----------------------------------------------|
|                                                                                                                                                                                                                                                                                                                   | A                                                                                                         | B | C |                                              |
| <b>4.1.4 Other features</b><br><br><b>4.1.4.1 Height of nuts</b><br><br><br><b>Figure 63</b>                                                                                                                                     | $d \leq 12 \text{ mm}$ : h14<br>$12 \text{ mm} < d \leq 18 \text{ mm}$ : h15<br>$d > 18 \text{ mm}$ : h16 |   |   | For slotted nuts and castle nuts see 4.1.5.1 |
| Prevailing torque type nuts (with non-metallic insert)<br><br><br>Prevailing torque type all metal hexagon nuts<br><br><br><b>Figure 64</b> | Tolerance of $h$ , see product standards                                                                  |   |   |                                              |

| Feature                                                                                                                                               | Tolerance for product grades                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   | Notes                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                       | A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | B | C |                                                                                                                                                                                                                                                                      |
| <div>4.1.4.2 Wrenching height</div> <div></div> <div>Figure 65</div> | <div><math>m_{w \min}^a = 0,8 m_{\min}</math></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   | <div><math>m_w</math> defines the length over which <math>e_{\min}</math> applies but excluding any chamfer or washer face specified in the appropriate product standard.</div> <div>The symbol <math>m_w</math> replaces the previously used <math>m'</math>.</div> |
| <div></div> <div>Figure 66</div>                                    | <div><math>m_{w \min}^b = 0,8 \times \left[ m_{\min} - \left( x + \frac{d_{w \min} - e_{\min}}{2} \tan \delta_{\max} \right) \right]</math></div> <div><math>x</math> is the greater of <math>c_{\min} \times 1,25</math> or <math>c_{\min} + 0,4</math></div> <div><math>\delta</math> is the flange angle</div> <div>Dimensions <math>m_w^a</math>, <math>m</math>, <math>d_w</math>, <math>e</math> and <math>\delta</math> are in accordance with ISO 225.</div> <div></div> |   |   | <div><sup>a</sup> The formulae for <math>m_{w \min}</math> only apply to the products illustrated.</div> <div><sup>b</sup> For gauging, see annex A of the product standards.</div>                                                                                  |

| Feature                                                                                                                                                                                                      | Tolerance for product grades                                                                                                                                          |                                            |                                            | Notes                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------------------|
|                                                                                                                                                                                                              | A                                                                                                                                                                     | B                                          | C                                          |                                                        |
| 4.1.4.3 Bearing face diameter and height of washer-faced portion<br><br><br>a Reference datum for $d_w$<br><b>Figure 67</b> | $d_{w \min} = s_{\min} - IT16$ for width across flats < 21 mm<br>$d_{w \min} = 0,95 s_{\min}$ for width across flats $\geq 21$ mm<br>$d_{w \max} = s_{\text{actual}}$ |                                            |                                            | Requirements apply to both sides of symmetrical parts. |
|                                                                                                                                                                                                              | Thread diameter                                                                                                                                                       | $c$                                        |                                            |                                                        |
|                                                                                                                                                                                                              |                                                                                                                                                                       | min.                                       | max.                                       |                                                        |
|                                                                                                                                                                                                              | $\geq 1,6$ to 2,5<br>> 2,5 to 4<br>> 4 to 6<br>> 6 to 14<br>> 14 to 36<br>> 36                                                                                        | 0,10<br>0,15<br>0,15<br>0,15<br>0,2<br>0,3 | 0,25<br>0,40<br>0,50<br>0,60<br>0,8<br>1,0 |                                                        |
|                                                                                                                                                                                                              |                                                                                                                                                                       |                                            |                                            |                                                        |
| <br><b>Figure 68</b>                                                                                                      | $d_{w \min}$ for hexagon nuts with flange in accordance with product standards                                                                                        |                                            |                                            |                                                        |

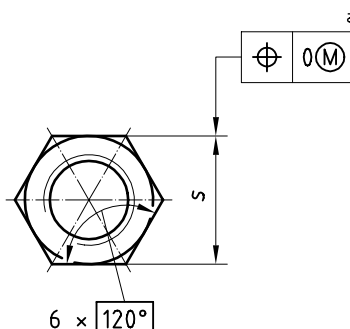
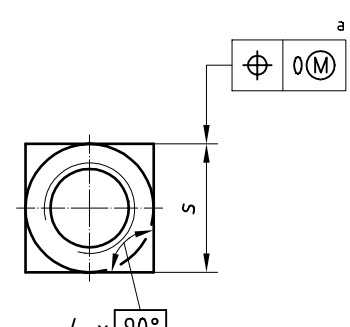
| Feature                                                                                                                                                                                                             | Tolerance for product grades                                                                                                                                                                                                                                                                                                                                                                                                |       |     | Notes                                                  |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----|--------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----------------------------------------------------------|--|--|--|--|--|
|                                                                                                                                                                                                                     | A                                                                                                                                                                                                                                                                                                                                                                                                                           | B     | C   |                                                        |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
| <div><p><math>\alpha = 90^\circ \text{ to } 120^\circ</math></p><p><b>Figure 69</b></p></div>                                     | $d \leq 5 \text{ mm} : d_{a \text{ max}} = 1,15d$<br>$5 \text{ mm} < d \leq 8 \text{ mm} : d_{a \text{ max}} = d + 0,75$<br>$d > 8 \text{ mm} : d_{a \text{ max}} = 1,08d$<br>for all sizes: $d_{a \text{ min}} = d$                                                                                                                                                                                                        |       |     | Requirements apply to both sides of symmetrical parts. |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
| <div><p><b>4.1.5 Special products</b></p><p><b>4.1.5.1 Castle nuts, slotted nuts</b></p><div><p><b>Figure 70</b></p></div></div> | <table><tr><td><math>d_e</math></td><td>h14</td><td>h15</td><td>h16</td></tr><tr><td><math>m</math></td><td>h14</td><td>h15</td><td>h17</td></tr><tr><td><math>n</math></td><td>H14</td><td>H14</td><td>H15</td></tr><tr><td><math>w</math></td><td>h14</td><td>h15</td><td>h17</td></tr><tr><td><math>m_w</math></td><td colspan="3">see <math>m_w</math>-values for hexagon nuts style 1 (see ISO 4032)</td></tr></table> | $d_e$ | h14 | h15                                                    | h16 | $m$ | h14 | h15 | h17 | $n$ | H14 | H14 | H15 | $w$ | h14 | h15 | h17 | $m_w$ | see $m_w$ -values for hexagon nuts style 1 (see ISO 4032) |  |  |  |  |  |
| $d_e$                                                                                                                                                                                                               | h14                                                                                                                                                                                                                                                                                                                                                                                                                         | h15   | h16 |                                                        |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
| $m$                                                                                                                                                                                                                 | h14                                                                                                                                                                                                                                                                                                                                                                                                                         | h15   | h17 |                                                        |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
| $n$                                                                                                                                                                                                                 | H14                                                                                                                                                                                                                                                                                                                                                                                                                         | H14   | H15 |                                                        |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
| $w$                                                                                                                                                                                                                 | h14                                                                                                                                                                                                                                                                                                                                                                                                                         | h15   | h17 |                                                        |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |
| $m_w$                                                                                                                                                                                                               | see $m_w$ -values for hexagon nuts style 1 (see ISO 4032)                                                                                                                                                                                                                                                                                                                                                                   |       |     |                                                        |     |     |     |     |     |     |     |     |     |     |     |     |     |       |                                                           |  |  |  |  |  |

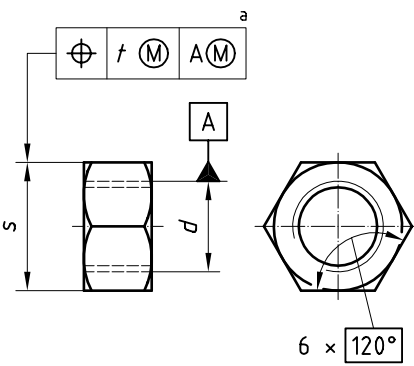
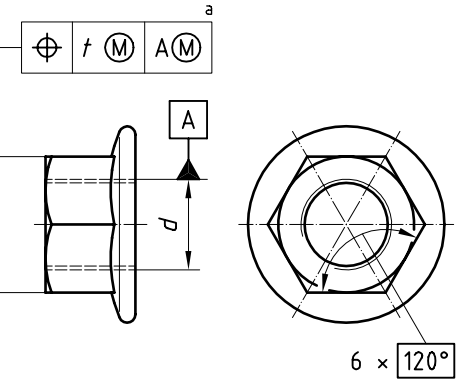
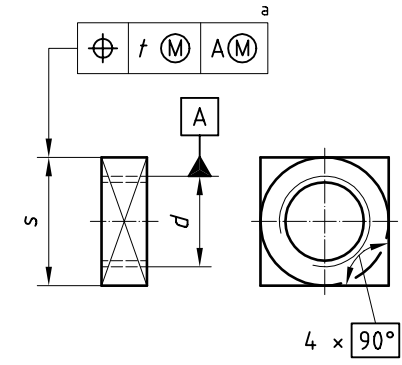
## 4.2 Geometrical tolerances

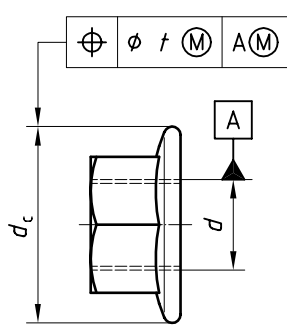
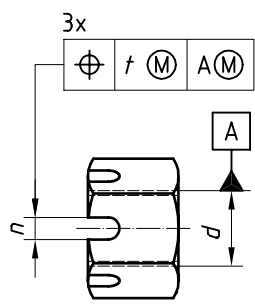
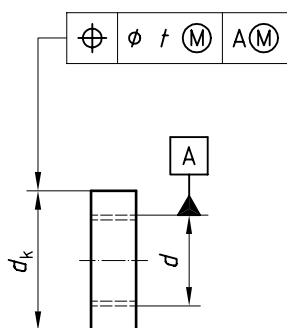
In accordance with ISO 1101 and ISO 2692 the tolerances specified in Figures 71 to 83 do not necessarily imply the use of any particular method of production, measurement or gauging.

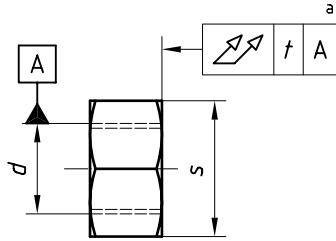
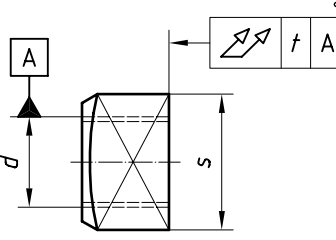
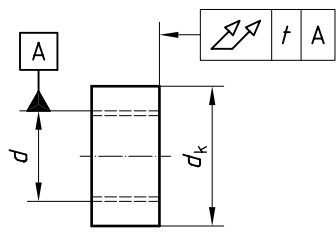
Where the nut thread is used as the datum the pitch diameter shall be the reference diameter.

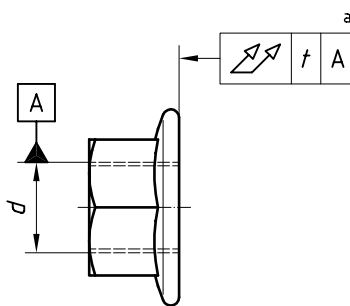
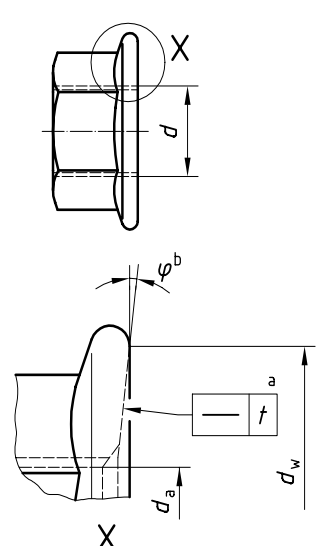
The maximum material principle in accordance with ISO 2692 is used.

| Feature                                                                                                                                                                                                                                                                                                                                                        | Tolerance $t$ for product grades |   |   | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---|---|-------|
|                                                                                                                                                                                                                                                                                                                                                                | A                                | B | C |       |
| <p><b>4.2.1 Driving features</b></p> <p><b>4.2.1.1 Tolerances of form</b></p>  <p>a 3 × simultaneously.</p> <p><b>Figure 71</b></p>  <p>a 2 × simultaneously.</p> <p><b>Figure 72</b></p> |                                  |   |   |       |

| Feature                                                                                                                                                                             | Tolerance $t$ for product grades |        |        | Tolerance $t$ based on dimensions | Notes |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------|--------|-----------------------------------|-------|
|                                                                                                                                                                                     | A                                | B      | C      |                                   |       |
| <b>4.2.1.2 Tolerances of position</b><br><br> <p>a 3 × simultaneously.</p> <p><b>Figure 73</b></p> | 2 IT13                           | 2 IT14 | 2 IT15 | s                                 |       |
|  <p>a 3 × simultaneously.</p> <p><b>Figure 74</b></p>                                             | 2 IT13                           | 2 IT14 | —      | s                                 |       |
|  <p>a 2 × simultaneously.</p> <p><b>Figure 75</b></p>                                            | 2 IT13                           | 2 IT14 | 2 IT15 | s                                 |       |

| Feature                                                                                                                                                                    | Tolerance $t$ for product grades |        |        | Tolerance $t$ based on dimensions | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------|--------|-----------------------------------|-------|
|                                                                                                                                                                            | A                                | B      | C      |                                   |       |
| <b>4.2.2 Other features</b><br><b>4.2.2.1 Tolerances of position</b><br> <p>Figure 76</p> | 2 IT14                           | 2 IT15 | —      | $d_c$                             |       |
|  <p>Figure 77</p>                                                                        | 2 IT13                           | 2 IT14 | 2 IT15 | $d$                               |       |
|  <p>Figure 78</p>                                                                       | 2 IT13                           | 2 IT14 | —      | $d_k$                             |       |

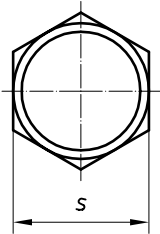
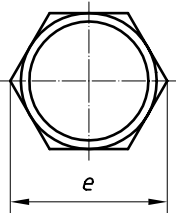
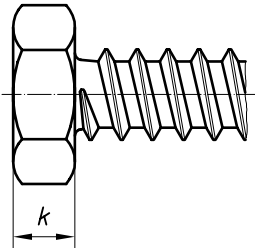
| Feature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Tolerance $t$ for product grades |   |      | Tolerance $t$ based on dimension | Notes                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---|------|----------------------------------|------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A                                | B | C    | $d$                              |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      |                                  |                                                                                    |
| <div>4.2.2.2 Tolerance of total run-out</div> <div></div> <div>a Up to 0,8s diameter only.</div> <div>Figure 79</div> <div></div> <div>a Up to Ø 0,8s only.</div> <div>Figure 80</div> <div></div> <div>a Up to Ø 0,8dk only.</div> <div>Figure 81</div> | 0,04                             |   | —    | 1,6                              | For symmetrical parts the perpendicularity requirement shall apply for both faces. |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,08                             |   |      | 2                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      | 2,5                              |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      | 3                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      | 3,5                              |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      | 4                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,15                             |   | 0,3  | 5                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,17                             |   | 0,34 | 6                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      | 7                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |   |      | 8                                |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,21                             |   | 0,42 | 10                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,25                             |   | 0,50 | 12                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,29                             |   | 0,58 | 14                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,34                             |   | 0,68 | 16                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,38                             |   | 0,76 | 18                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,42                             |   | 0,84 | 20                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,46                             |   | 0,92 | 22                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,50                             |   | 1    | 24                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,57                             |   | 1,14 | 27                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,63                             |   | 1,26 | 30                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,69                             |   | 1,38 | 33                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,76                             |   | 1,52 | 36                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,82                             |   | 1,64 | 39                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,44                             |   | 0,88 | 42                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,47                             |   | 0,94 | 45                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,50                             |   | 1    | 48                               |                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0,55                             |   | 1,1  | 52                               |                                                                                    |

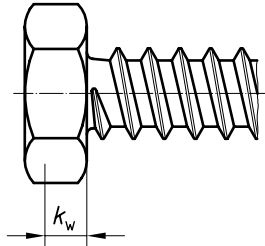
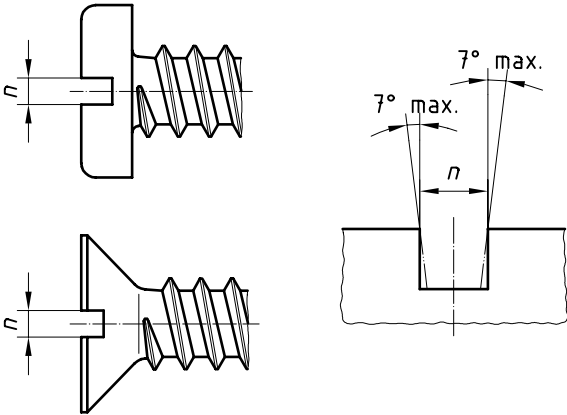
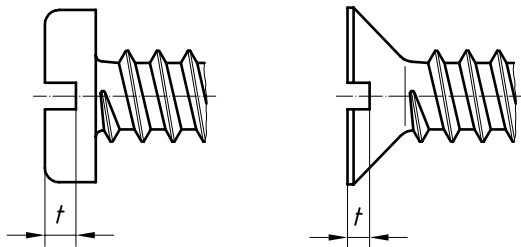
| Feature                                                                                                                                                                                                                                                                                                          | Tolerance $t$ for product grades              |   |   | Notes |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---|---|-------|
|                                                                                                                                                                                                                                                                                                                  | A                                             | B | C |       |
|  <p>a Line of highest points on any radial line.</p> <p><b>Figure 82</b></p>                                                                                                                                                    | For $t$ see values for Figures 79, 80 and 81. |   |   |       |
| <p><b>4.2.2.3 Permissible deviation from the shape of bearing face</b></p>  <p>a Radial lines between <math>d_{a \max}</math> and <math>d_{w \min}</math>.</p> <p>b According to product standard.</p> <p><b>Figure 83</b></p> | 0,005d                                        |   |   |       |

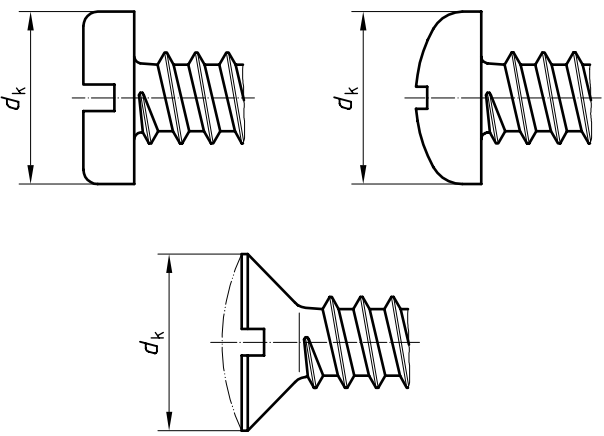
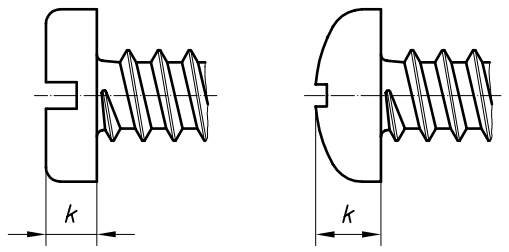
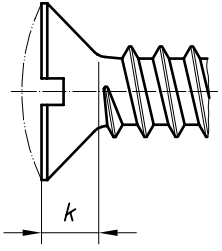
5 Tolerances for tapping screws

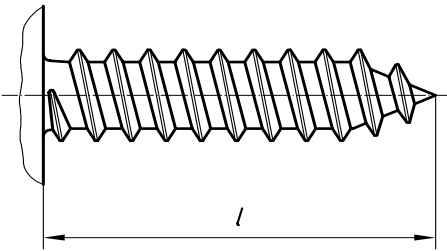
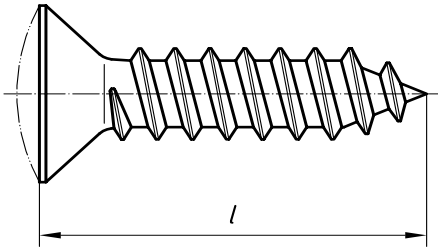
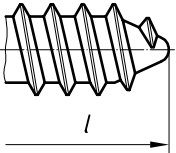
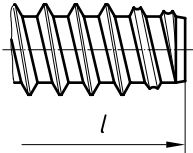
5.1 Dimensional tolerances — Product grade A

Symbols and designations of dimensions are specified in ISO 225.

| Feature                                                                                          | Tolerance                   | Notes                                                                                                        |
|--------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------|
| 5.1.1 Thread                                                                                     | see ISO 1478                |                                                                                                              |
| 5.1.2 Driving features                                                                           |                             |                                                                                                              |
| 5.1.2.1 External                                                                                 |                             |                                                                                                              |
| 5.1.2.1.1 Width across flats                                                                     |                             |                                                                                                              |
| <br>Figure 84  | h13                         |                                                                                                              |
| 5.1.2.1.2 Width across corners                                                                   |                             |                                                                                                              |
| <br>Figure 85 | $e_{\min} = 1,12 s_{\min}$  |                                                                                                              |
| 5.1.2.1.3 Height of head                                                                         |                             |                                                                                                              |
| <br>Figure 86 | For tolerances see ISO 1479 | For tapping screws with hexagon flange head and hexagon washer head see ISO 7053 and ISO 10509 respectively. |

| Feature                                                                                                                                                                            | Tolerance                                                                                                                                                                                                                                                                                 | Notes                                                                                                                                                                                                        |                        |          |                  |              |                  |              |                  |                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|----------|------------------|--------------|------------------|--------------|------------------|---------------------------------------------------------------------------------------------------------------------------|
| <div>5.1.2.1.4 Wrenching height</div> <div></div> <div>Figure 87</div>                            | <div><math>k_w \text{ min.} = 0,7 k_{\text{min}}</math></div>                                                                                                                                                                                                                             | <div>For tapping screws with hexagon flange head and hexagon washer head see ISO 7053 and ISO 10509 respectively.</div> <div>The symbol <math>k_w</math> replaces the previously used <math>k'</math>.</div> |                        |          |                  |              |                  |              |                  |                                                                                                                           |
| <div>5.1.2.2 Internal</div> <div>5.1.2.2.1 Width of slots</div> <div></div> <div>Figure 88</div> | <table><tr><th><math>n</math></th><th>Tolerance <sup>a</sup></th></tr><tr><td><math>\leq 1</math></td><td>+ 0,20<br/>+ 0,06</td></tr><tr><td><math>&gt; 1 \leq 3</math></td><td>+ 0,31<br/>+ 0,06</td></tr><tr><td><math>&gt; 3 \leq 6</math></td><td>+ 0,37<br/>+ 0,07</td></tr></table> | $n$                                                                                                                                                                                                          | Tolerance <sup>a</sup> | $\leq 1$ | + 0,20<br>+ 0,06 | $> 1 \leq 3$ | + 0,31<br>+ 0,06 | $> 3 \leq 6$ | + 0,37<br>+ 0,07 | <div><sup>a</sup> Tolerance field</div> <div>C13 for <math>n \leq 1</math></div> <div>C14 for <math>n &gt; 1</math></div> |
| $n$                                                                                                                                                                                | Tolerance <sup>a</sup>                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                              |                        |          |                  |              |                  |              |                  |                                                                                                                           |
| $\leq 1$                                                                                                                                                                           | + 0,20<br>+ 0,06                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                              |                        |          |                  |              |                  |              |                  |                                                                                                                           |
| $> 1 \leq 3$                                                                                                                                                                       | + 0,31<br>+ 0,06                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                              |                        |          |                  |              |                  |              |                  |                                                                                                                           |
| $> 3 \leq 6$                                                                                                                                                                       | + 0,37<br>+ 0,07                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                              |                        |          |                  |              |                  |              |                  |                                                                                                                           |
| <div>5.1.2.2.2 Depth of slots</div> <div></div> <div>Figure 89</div>                            | <div>The depth of slots is specified in product standards.</div>                                                                                                                                                                                                                          |                                                                                                                                                                                                              |                        |          |                  |              |                  |              |                  |                                                                                                                           |

| Feature                                                                                                                                                                                                        | Tolerance                                                                                                            | Notes                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>5.1.2.2.3 Cross recesses</b>                                                                                                                                                                                | See ISO 4757 for all dimensions except penetration depths. For penetration depths see appropriate product standard.  |                                                                                               |
| <b>5.1.2.2.4 Hexalobular recess</b>                                                                                                                                                                            | See ISO 10664 for all dimensions except penetration depths. For penetration depths see appropriate product standard. |                                                                                               |
| <b>5.1.3 Other features</b><br><br><b>5.1.3.1 Head diameters</b><br><br> <p style="text-align: center;"><b>Figure 90</b></p> | h14                                                                                                                  | Combined control of diameter and height for countersunk head screws as specified in ISO 7721. |
| <b>5.1.3.2 Head height</b><br><br> <p style="text-align: center;"><b>Figure 91</b></p>                                      | h14                                                                                                                  |                                                                                               |
|  <p style="text-align: center;"><b>Figure 92</b></p>                                                                        | For countersunk head screws $k$ is defined in product standards only as a maximum.                                   | Combined control of diameter and height for countersunk head screws as specified in ISO 7721. |

| Feature                                                                             | Tolerance | Notes |
|-------------------------------------------------------------------------------------|-----------|-------|
| 5.1.3.3 Length                                                                      |           |       |
|    |           |       |
|    |           |       |
| Type C                                                                              |           |       |
|  |           |       |
| Type R                                                                              |           |       |
|  |           |       |
| Type F                                                                              |           |       |
| Figure 93                                                                           |           |       |

| Types C and R |           |
|---------------|-----------|
| <i>l</i>      | Tolerance |
| ≤ 25          | ± 0,8     |
| > 25          | ± 1,3     |

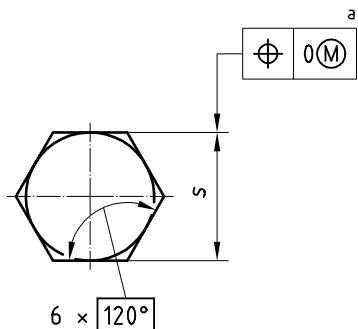
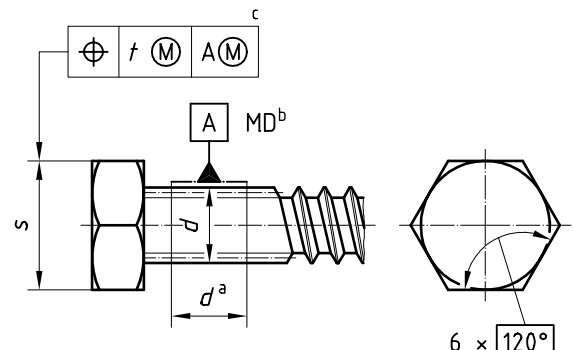
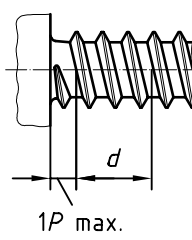
| Type F    |            |
|-----------|------------|
| <i>l</i>  | Tolerance  |
| ≤ 19      | 0<br>- 0,8 |
| > 19 ≤ 38 | 0<br>- 1,3 |
| > 38      | 0<br>- 1,5 |

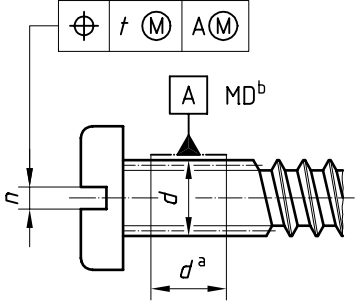
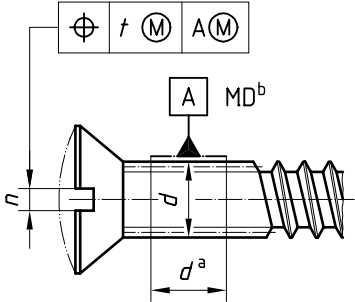
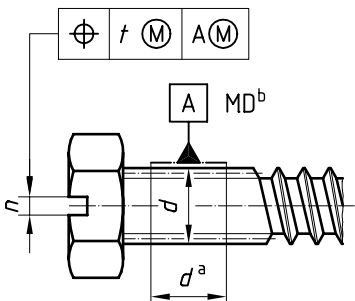
## 5.2 Geometrical tolerances — Product grade A

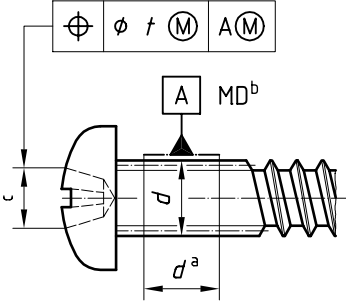
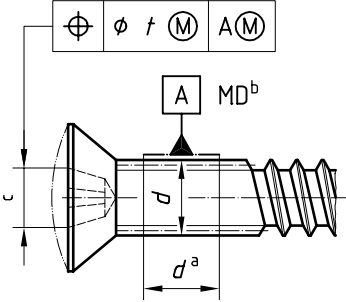
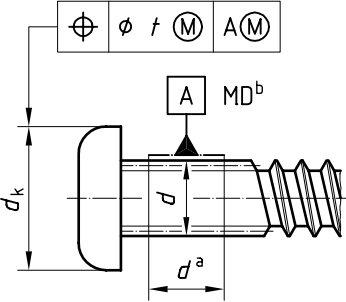
In accordance with ISO 1101 and ISO 2692 the tolerances of form and position indicated in Figures 94 to 104 do not necessarily imply the use of any particular method of production, measurement or gauging.

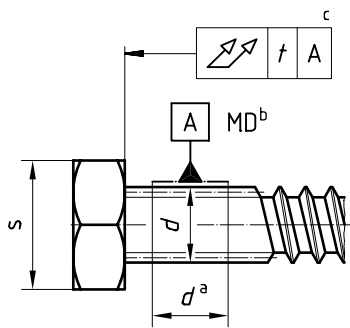
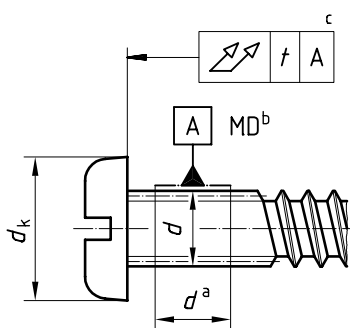
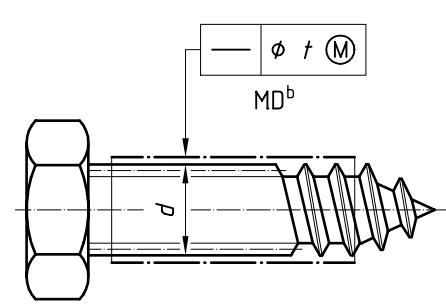
Where a tapping screw thread is indicated either as the datum or as the tolerated feature the axis shall be determined from the major diameter of the thread.

The maximum material principle in accordance with ISO 2692 is used.

| Feature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Tolerance $t$ | Tolerance $t$ based on dimension | Notes                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <p><b>5.2.1 Driving features</b></p> <p><b>5.2.1.1 Tolerance of form</b></p>  <p><sup>a</sup> 3 × simultaneously.</p> <p><b>Figure 94</b></p>                                                                                                                                                                                                                                                                                                                     |               |                                  |                                                                                                                    |
| <p><b>5.2.1.2 Tolerances of position</b></p>  <p><sup>a</sup> The datum A shall be as close to the head as possible but within 1 <math>P</math> distance of the head. It shall not include the thread run-out or underhead fillet.</p> <p><sup>b</sup> MD means that tolerance applies in relation to the axis of the cylinder derived from the major thread diameter according to ISO 1101.</p> <p><sup>c</sup> 3 × simultaneously.</p> <p><b>Figure 95</b></p> | 2 IT13        | $s$                              |  <p>1 <math>P</math> max.</p> |

| Feature                                                                                                                                | Tolerance $t$ | Tolerance $t$ based on dimension | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|-------|
|  <p>a, b See Figure 95.</p> <p><b>Figure 96</b></p>   | 2 IT12        | $d$                              |       |
|  <p>a, b See Figure 95.</p> <p><b>Figure 97</b></p>  |               |                                  |       |
|  <p>a, b See Figure 95.</p> <p><b>Figure 98</b></p> |               |                                  |       |

| Feature                                                                                                                                                                                                                                                                                            | Tolerance <i>t</i> | Tolerance <i>t</i> based on dimension | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------|-------|
|                                                                                                                                                                                                                   | 2 IT13             | <i>d</i>                              |       |
| <p>a, b See Figure 95.</p> <p>c For referee purposes assessment of co-axiality of cross recess features shall be by means of a penetration gauge point in accordance with ISO 4757.</p> <p><b>Figure 99</b></p>  | 2 IT13             | <i>d</i>                              |       |
| <p>a, b See Figure 95.</p> <p>c See Figure 99.</p> <p><b>Figure 100</b></p>                                                                                                                                                                                                                        |                    |                                       |       |
| <p><b>5.2.2 Other features</b></p> <p><b>5.2.2.1 Tolerance of position</b></p>                                                                                                                                  | 2 IT13             | <i>d<sub>k</sub></i>                  |       |
| <p>a, b See Figure 95.</p> <p><b>Figure 101</b></p>                                                                                                                                                                                                                                                |                    |                                       |       |

| Feature                                                                                                                                                                                                                                                                                                                                                                                                  | Tolerance $t$                                                                                                                                                                                                                                                                                                                                                               | Tolerance $t$ based on dimension | Notes            |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------|-------|------|-------|------|-------|------|-------|------|-------|-----|-------|-----|-------|-----|-----|------|-------|------|---------------------------|-----------------------------------------------------------------------------------------------------------------|
| <div>5.2.2.2 Total run-out</div> <div></div> <div>a, b See Figure 95.<br/>c Up to 0,8s diameter only.</div> <div>Figure 102</div> <div></div> <div>a, b See Figure 95.<br/>c up to 0,8 d_k diameter only.</div> <div>Figure 103</div> | <table><tr><th>d</th><th>t</th></tr><tr><td>ST2,2</td><td>0,08</td></tr><tr><td>ST2,9</td><td>0,16</td></tr><tr><td>ST3,5</td><td>0,16</td></tr><tr><td>ST4,2</td><td>0,16</td></tr><tr><td>ST4,8</td><td>0,3</td></tr><tr><td>ST5,5</td><td>0,3</td></tr><tr><td>ST6,3</td><td>0,3</td></tr><tr><td>ST8</td><td>0,34</td></tr><tr><td>ST9,5</td><td>0,42</td></tr></table> | d                                | t                | ST2,2 | 0,08 | ST2,9 | 0,16 | ST3,5 | 0,16 | ST4,2 | 0,16 | ST4,8 | 0,3 | ST5,5 | 0,3 | ST6,3 | 0,3 | ST8 | 0,34 | ST9,5 | 0,42 | <div>d</div> <div>d</div> | <div>Tolerance <math>t</math> calculated as follows:<br/><math>t \approx 1,2 d \times \tan 2^\circ</math></div> |
| d                                                                                                                                                                                                                                                                                                                                                                                                        | t                                                                                                                                                                                                                                                                                                                                                                           |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST2,2                                                                                                                                                                                                                                                                                                                                                                                                    | 0,08                                                                                                                                                                                                                                                                                                                                                                        |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST2,9                                                                                                                                                                                                                                                                                                                                                                                                    | 0,16                                                                                                                                                                                                                                                                                                                                                                        |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST3,5                                                                                                                                                                                                                                                                                                                                                                                                    | 0,16                                                                                                                                                                                                                                                                                                                                                                        |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST4,2                                                                                                                                                                                                                                                                                                                                                                                                    | 0,16                                                                                                                                                                                                                                                                                                                                                                        |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST4,8                                                                                                                                                                                                                                                                                                                                                                                                    | 0,3                                                                                                                                                                                                                                                                                                                                                                         |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST5,5                                                                                                                                                                                                                                                                                                                                                                                                    | 0,3                                                                                                                                                                                                                                                                                                                                                                         |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST6,3                                                                                                                                                                                                                                                                                                                                                                                                    | 0,3                                                                                                                                                                                                                                                                                                                                                                         |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST8                                                                                                                                                                                                                                                                                                                                                                                                      | 0,34                                                                                                                                                                                                                                                                                                                                                                        |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| ST9,5                                                                                                                                                                                                                                                                                                                                                                                                    | 0,42                                                                                                                                                                                                                                                                                                                                                                        |                                  |                  |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |
| <div>5.2.2.3 Straightness</div> <div></div> <div>b See Figure 95.</div> <div>Figure 104</div>                                                                                                                                                                                                                         | $t = 0,003l + 0,05$                                                                                                                                                                                                                                                                                                                                                         | —                                | for $l \leq 20d$ |       |      |       |      |       |      |       |      |       |     |       |     |       |     |     |      |       |      |                           |                                                                                                                 |

## Annex A (informative)

### Tolerances

Numerical values of IT tolerance grades are given in Table A.1 and the limit deviations for shafts and for holes are given in Tables A.2 and A.3 respectively. These tolerances are taken from ISO 286-1 and ISO 286-2.

**Table A.1 — Numerical values of standard tolerance grades IT for basic sizes up to 500 mm**

| Nominal dimension |     | Standard tolerance grades |      |      |      |      |      |
|-------------------|-----|---------------------------|------|------|------|------|------|
| >                 | ≤   | IT12                      | IT13 | IT14 | IT15 | IT16 | IT17 |
| Tolerances        |     |                           |      |      |      |      |      |
|                   | 3   | 0,1                       | 0,14 | 0,25 | 0,4  | 0,6  | 1    |
| 3                 | 6   | 0,12                      | 0,18 | 0,3  | 0,48 | 0,75 | 1,2  |
| 6                 | 10  | 0,15                      | 0,22 | 0,36 | 0,58 | 0,9  | 1,5  |
| 10                | 18  | 0,18                      | 0,27 | 0,43 | 0,7  | 1,1  | 1,8  |
| 18                | 30  | 0,21                      | 0,33 | 0,52 | 0,84 | 1,3  | 2,1  |
| 30                | 50  | 0,25                      | 0,39 | 0,62 | 1    | 1,6  | 2,5  |
| 50                | 80  | 0,3                       | 0,46 | 0,74 | 1,2  | 1,9  | 3    |
| 80                | 120 | 0,35                      | 0,54 | 0,87 | 1,4  | 2,2  | 3,5  |
| 120               | 180 | 0,4                       | 0,63 | 1    | 1,6  | 2,5  | 4    |
| 180               | 250 | 0,46                      | 0,72 | 1,15 | 1,85 | 2,9  | 4,6  |
| 250               | 315 | 0,52                      | 0,81 | 1,3  | 2,1  | 3,2  | 5,2  |
| 315               | 400 | 0,57                      | 0,89 | 1,4  | 2,3  | 3,6  | 5,7  |
| 400               | 500 | 0,63                      | 0,97 | 1,55 | 2,5  | 4    | 6,3  |

**Table A.2 — Limit deviations for shafts**

| Nominal dimension |     | Limit deviations |            |            |            |           |         |         |         |        |
|-------------------|-----|------------------|------------|------------|------------|-----------|---------|---------|---------|--------|
| >                 | ≤   | h13              | h14        | h15        | h16        | h17       | js14    | js15    | js16    | js17   |
|                   | 3   | 0<br>−0,14       | 0<br>−0,25 | 0<br>−0,4  | 0<br>−0,6  | 0<br>−1   | ± 0,125 | ± 0,2   | ± 0,3   | ± 0,5  |
| 3                 | 6   | 0<br>−0,18       | 0<br>−0,3  | 0<br>−0,48 | 0<br>−0,75 | 0<br>−1,2 | ± 0,15  | ± 0,24  | ± 0,375 | ± 0,6  |
| 6                 | 10  | 0<br>−0,22       | 0<br>−0,36 | 0<br>−0,58 | 0<br>−0,9  | 0<br>−1,5 | ± 0,18  | ± 0,29  | ± 0,45  | ± 0,75 |
| 10                | 18  | 0<br>−0,27       | 0<br>−0,43 | 0<br>−0,7  | 0<br>−1,1  | 0<br>−1,8 | ± 0,215 | ± 0,35  | ± 0,55  | ± 0,9  |
| 18                | 30  | 0<br>−0,33       | 0<br>−0,52 | 0<br>−0,84 | 0<br>−1,3  | 0<br>−2,1 | ± 0,26  | ± 0,42  | ± 0,65  | ± 1,05 |
| 30                | 50  | 0<br>−0,39       | 0<br>−0,62 | 0<br>−1    | 0<br>−1,6  | 0<br>−2,5 | ± 0,31  | ± 0,5   | ± 0,8   | ± 1,25 |
| 50                | 80  | 0<br>−0,46       | 0<br>−0,74 | 0<br>−1,2  | 0<br>−1,9  | 0<br>−3,0 | ± 0,37  | ± 0,6   | ± 0,95  | ± 1,5  |
| 80                | 120 | 0<br>−0,54       | 0<br>−0,87 | 0<br>−1,4  | 0<br>−2,2  | 0<br>−3,5 | ± 0,435 | ± 0,7   | ± 1,1   | ± 1,75 |
| 120               | 180 | 0<br>−0,63       | 0<br>−1    | 0<br>−1,6  | 0<br>−2,5  | 0<br>−4   | ± 0,5   | ± 0,8   | ± 1,25  | ± 2    |
| 180               | 250 | 0<br>−0,72       | 0<br>−1,15 | 0<br>−1,85 | 0<br>−2,9  | 0<br>−4,6 | ± 0,575 | ± 0,925 | ± 1,45  | ± 2,3  |
| 250               | 315 | 0<br>−0,81       | 0<br>−1,3  | 0<br>−2,1  | 0<br>−3,2  | 0<br>−5,2 | ± 0,65  | ± 1,05  | ± 1,6   | ± 2,6  |
| 315               | 400 | 0<br>−0,89       | 0<br>−1,4  | 0<br>−2,3  | 0<br>−3,6  | 0<br>−5,7 | ± 0,7   | ± 1,15  | ± 1,8   | ± 2,85 |
| 400               | 500 | 0<br>−0,97       | 0<br>−1,55 | 0<br>−2,5  | 0<br>−4    | 0<br>−6,3 | ± 0,775 | ± 1,25  | ± 2     | ± 3,15 |

Table A.3 — Limit deviations for holes

| Nominal dimension |     | Limit deviations |                |                 |                 |                 |                  |                  |                  |                  |            |            |          |             |
|-------------------|-----|------------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------|------------|----------|-------------|
| >                 | ≤   | C13              | C14            | D9              | D10             | D11             | D12              | EF8              | 11               | E12              | H14        | H15        | JS9      | K9          |
|                   | 3   | +0,2<br>+0,06    | +0,31<br>+0,06 | +0,045<br>+0,02 | +0,06<br>+0,02  | +0,08<br>+0,02  | +0,12<br>+0,02   | +0,024<br>+0,01  | +0,074<br>+0,014 | +0,114<br>+0,014 | +0,25<br>0 | +0,4<br>0  | ±0,012 5 | 0<br>−0,025 |
| 3                 | 6   | +0,25<br>+0,07   | +0,37<br>+0,07 | +0,06<br>+0,03  | +0,078<br>+0,03 | +0,105<br>+0,03 | +0,15<br>+0,03   | +0,032<br>+0,014 | +0,095<br>+0,02  | +0,14<br>+0,02   | +0,3<br>0  | +0,48<br>0 | ±0,015   | 0<br>−0,03  |
| 6                 | 10  |                  |                |                 |                 | +0,13<br>+0,04  | +0,19<br>+0,04   | +0,04<br>+0,018  | +0,115<br>+0,025 | +0,175<br>+0,025 | +0,36<br>0 | +0,58<br>0 | ±0,018   | 0<br>−0,036 |
| 10                | 18  |                  |                |                 |                 |                 | +0,23<br>+0,05   |                  | +0,142<br>+0,032 | +0,212<br>+0,032 | +0,43<br>0 | +0,7<br>0  |          |             |
| 18                | 30  |                  |                |                 |                 |                 | +0,275<br>+0,065 |                  |                  |                  | +0,52<br>0 | +0,84<br>0 |          |             |
| 30                | 50  |                  |                |                 |                 |                 | +0,33<br>+0,08   |                  |                  |                  | +0,62<br>0 | +1<br>0    |          |             |
| 50                | 80  |                  |                |                 |                 |                 | +0,4<br>+0,1     |                  |                  |                  | +0,74<br>0 | +1,2<br>0  |          |             |
| 80                | 120 |                  |                |                 |                 |                 | +0,47<br>+0,12   |                  |                  |                  | +0,87<br>0 | +1,4<br>0  |          |             |
| 120               | 180 |                  |                |                 |                 |                 |                  |                  |                  |                  | +1<br>0    | +1,6<br>0  |          |             |
| 180               | 250 |                  |                |                 |                 |                 |                  |                  |                  |                  | +1,15<br>0 | +1,85<br>0 |          |             |
| 250               | 315 |                  |                |                 |                 |                 |                  |                  |                  |                  | +1,3<br>0  | +2,1<br>0  |          |             |
| 315               | 400 |                  |                |                 |                 |                 |                  |                  |                  |                  | +1,4<br>0  | +2,3<br>0  |          |             |
| 400               | 500 |                  |                |                 |                 |                 |                  |                  |                  |                  | +1,55<br>0 | +2,5<br>0  |          |             |

## Annex B (informative)

### Examples of dimensioned and toleranced fasteners

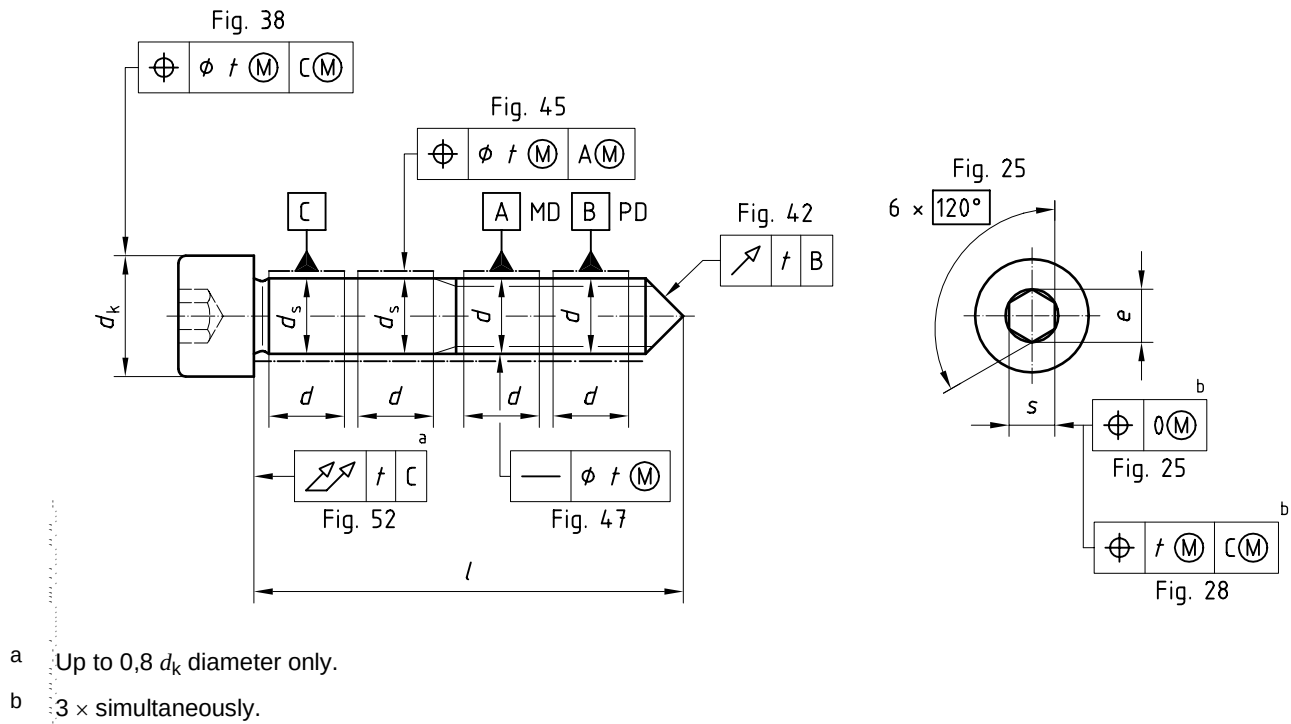
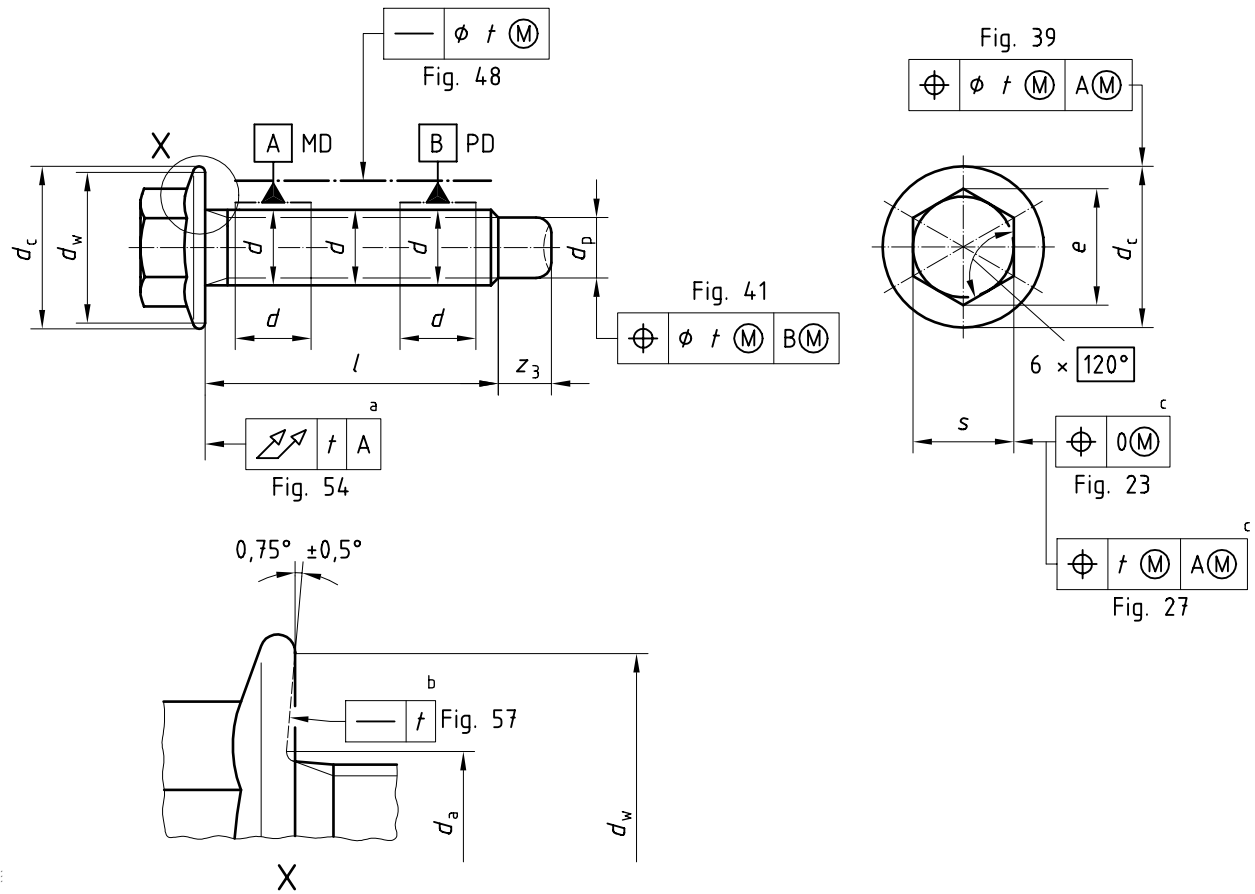
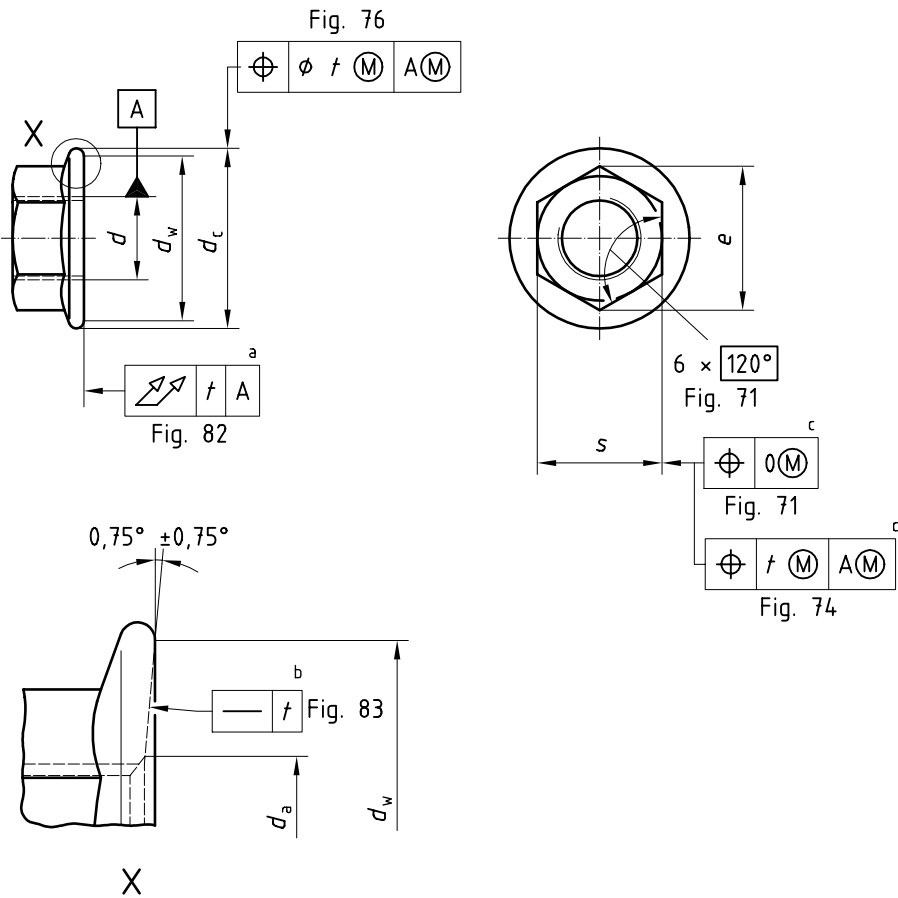


Figure B.1 — Hexagon socket head cap screw with shank and cone point



- a Line of highest points on any radial line.
- b Radial lines between  $d_{a \max}$  and  $d_{w \min}$ .
- c 3 × simultaneously.

Figure B.2 — Hexagon head bolt with flange and pilot point



- a Line of highest points on any radial line.
- b Radial lines between  $d_{a \max}$  and  $d_{w \min}$ .
- c 3 × simultaneously.

Figure B.3 — Hexagon nut with flange

## Annex C (informative)

### Examples of gauges and other measuring devices

#### C.1 Application

This annex gives examples of gauges and other measuring devices which can verify whether the tolerances specified in this part of ISO 4759 are satisfied.

The thread of gauges and measuring devices shall be within the limits for GO gauges. Guides shall have such an accuracy that errors due to the guides during inspection are negligible compared to the workpiece tolerance  $t$  (e.g. less than 10 % of  $t$ ).

If the datum is not associated with the maximum material requirements, indicated by  $\textcircled{M}$ , the following applies:

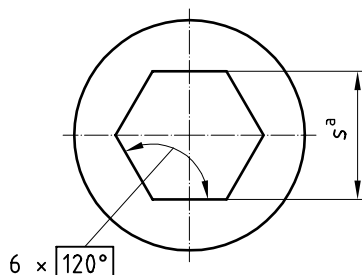
- when the datum is an external thread, the major diameter axis (MD) or the pitch diameter axis (PD) is the datum as specified in this part of ISO 4759. When the datum is the major diameter, the part may be fixed in a 3 jaw chuck;
- when the datum is an internal thread, in the examples of this annex the nut is tightened against a conical spring washer. Another possibility is to use a tapered threaded mandrel for this purpose;
- when the datum is a plain shaft or a tapping screw thread it may be fixed in a 3 jaw chuck regardless of the feature size;

#### C.2 Gauges and other measuring devices

NOTE All gauges given in this annex are GO gauges. Diameter  $d_g$ , if existant, should be chosen by the gauge manufacturer.

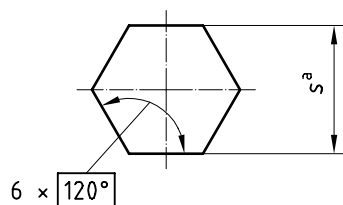
The gauges and measuring devices given in this annex are intended for the verification of geometrical tolerances specified in 3.2, 4.2 and 5.2.

Each gauge and measuring device is allocated to one or more figures in the main body of this part of ISO 4759 in order to make clear which tolerance is verified by which gauge or measuring device.



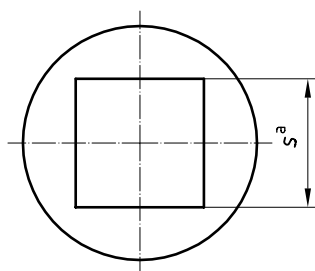
a Maximum material size.

Figure C.1 — Gauge for verifying form tolerance specified in Figures 23, 71 and 94



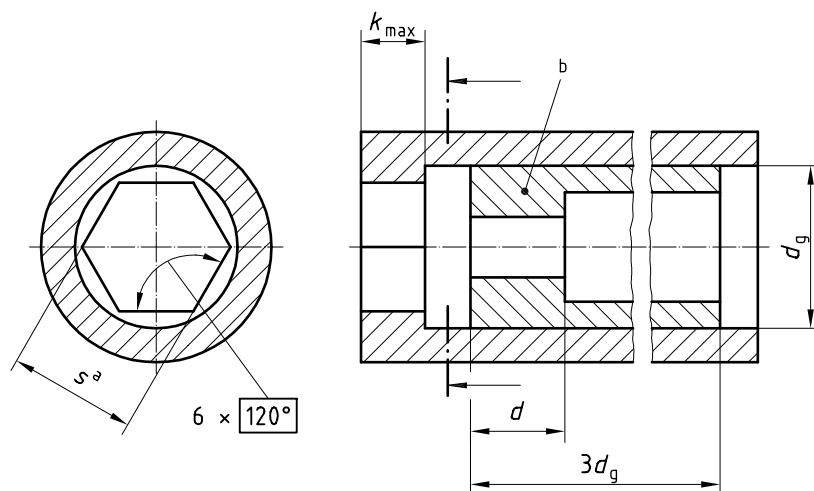
- a Maximum material size.

**Figure C.2 — Gauge for verifying form tolerance specified in figure 25**



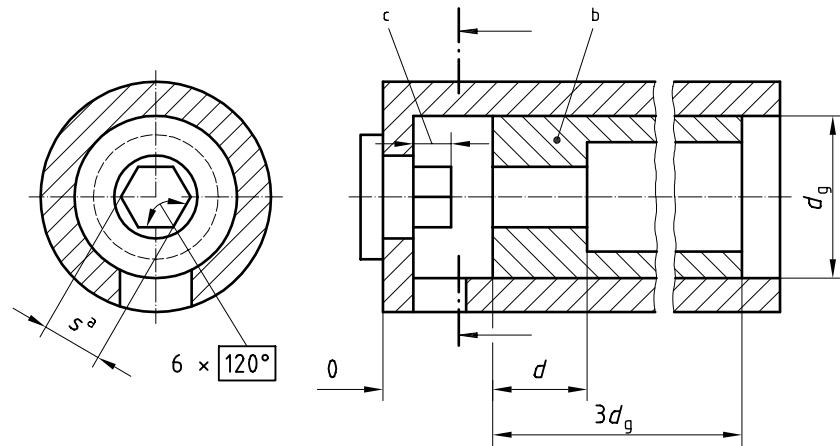
- a Maximum material size.

**Figure C.3 — Gauge for verifying form tolerance specified in Figures 24 and 72**



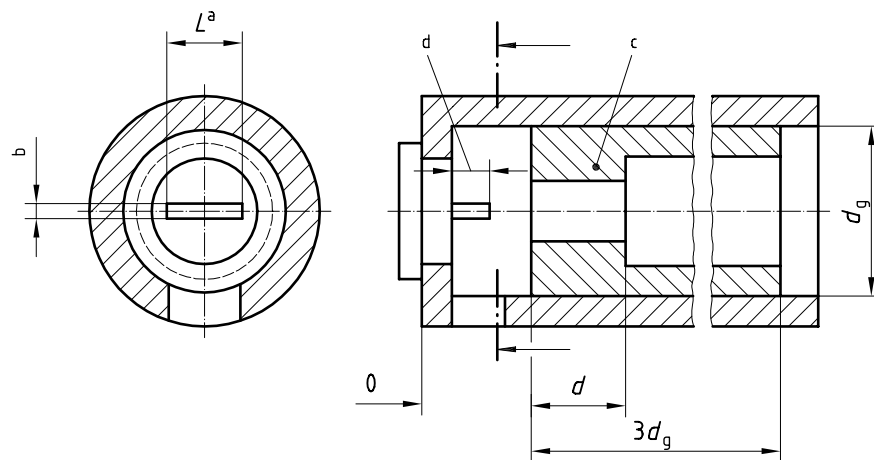
- a Maximum material size +  $t$ .  
b The GO gauge is a plain hole of maximum material size.

**Figure C.4 — Gauge for verifying position tolerance specified in Figures 26, 27 and 95**



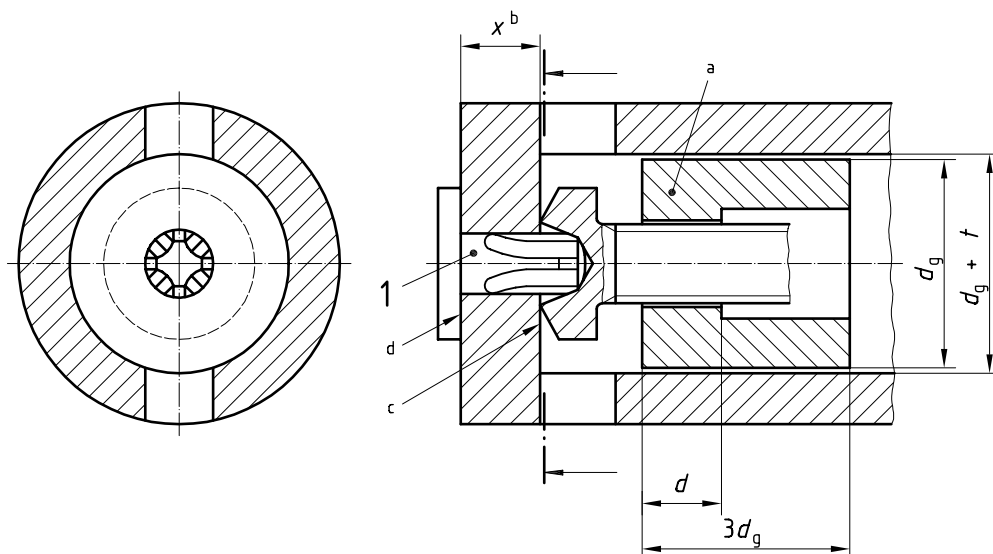
- a Maximum material size –  $t$ .
- b The GO gauge is a plain hole of maximum material size.
- c Minimum socket depth.

**Figure C.5 — gauge for verifying position tolerance specified in Figures 28, 29, 30 and 31**



- a  $L > s$  (see Figures 32 and 98);  $L > d_k$  (see Figures 33, 34, 96 and 97);  $L > d$  (see Figure 35).
- b Maximum material size –  $t$ .
- c The GO gauge is a plain hole of maximum material size.
- d Minimum slot depth.

**Figure C.6 — Gauge for verifying position tolerance specified in Figures 32, 33, 34, 35, 96, 97 and 98**



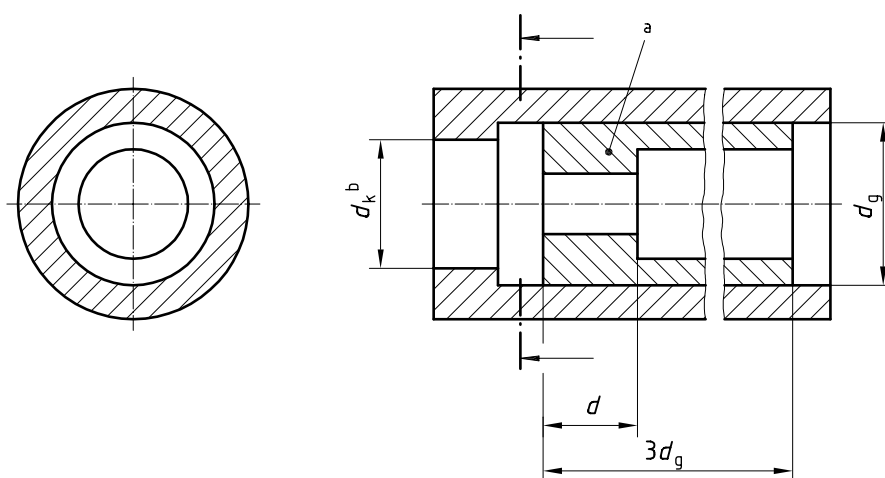
**Key**

1 Gauge pin in accordance with ISO 4757

NOTE This gauge does not check the size of the recess, e.g. an oversized cross recess is not recognized.

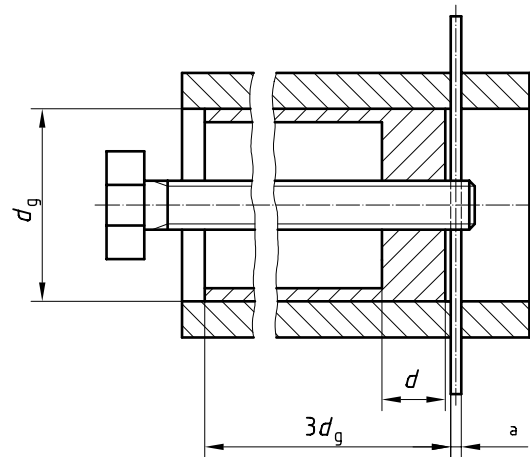
- a The GO gauge is a plain hole of maximum material size.
- b  $x$  is a function of length of gauge pin and the required penetration of the recess.
- c First contact.
- d Contact shall be achieved.

**Figure C.7 — Gauge for verifying position tolerance specified in Figures 36, 37, 99 and 100**



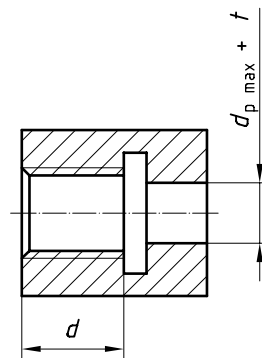
- a The GO gauge is a plain hole of maximum material size.
- b Maximum material size +  $t$ .

**Figure C.8 — Gauge for verifying position tolerance specified in Figures 38, 39 and 101**

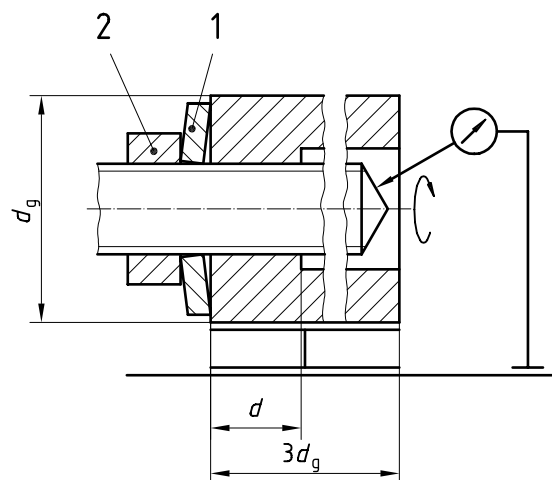


a Maximum material size –  $t$

**Figure C.9 — Gauge for verifying position tolerance specified in Figure 40**



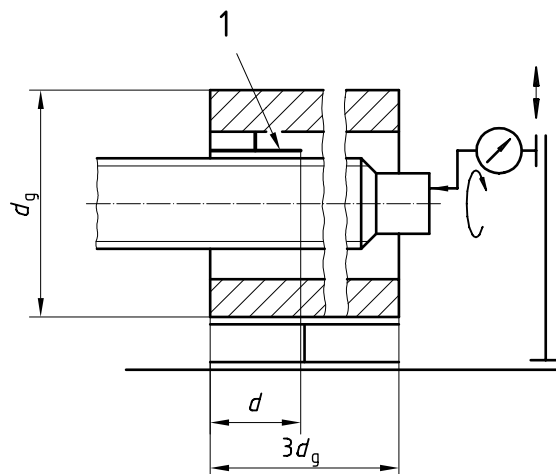
**Figure C.10 — Gauge for verifying position tolerance specified in Figure 41**



**Key**

- 1 Gauge conical spring washer
- 2 Gauge counter nut

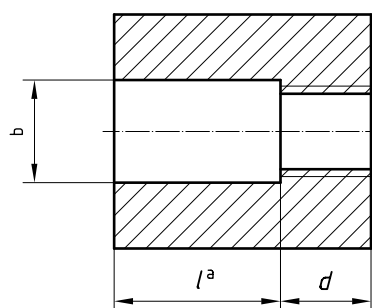
**Figure C.11 — Measuring device for verifying run-out specified in Figures 42 and 43**



**Key**

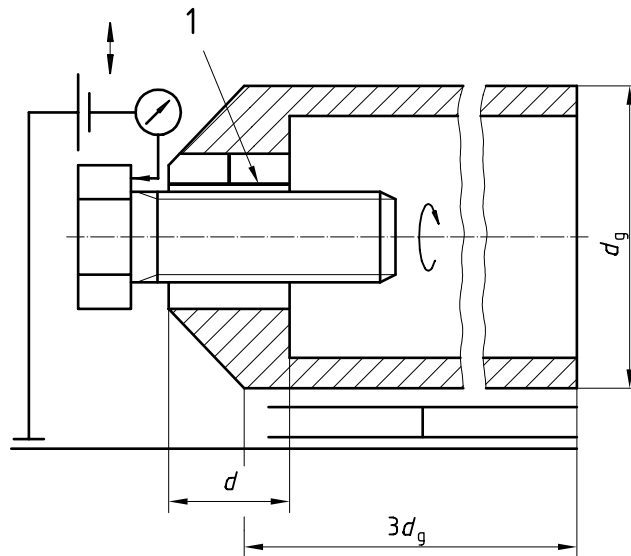
- 1 Three jaw chuck

**Figure C.12 — Measuring device for verifying total run-out specified in Figure 56**



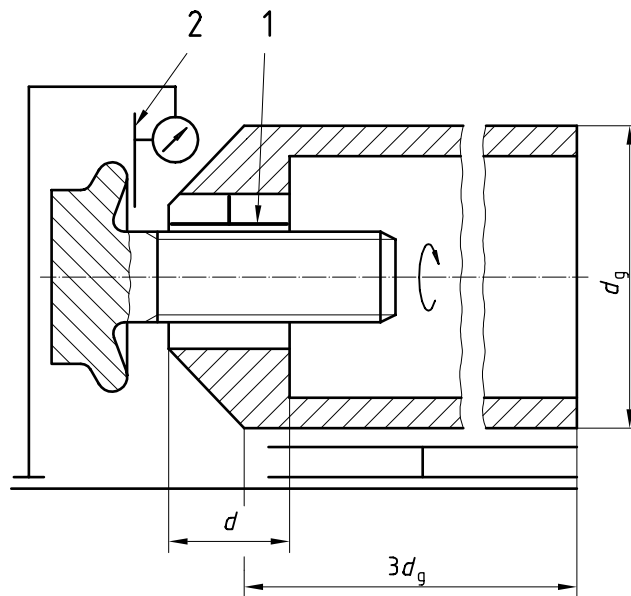
- a  $l$  depends on the distance between the datum feature and the end of the tolerated feature.  
b Maximum material size +  $t$ .

**Figure C.13 — Gauge for verifying position tolerance specified in Figures 44, 45 and 46**

**Key**

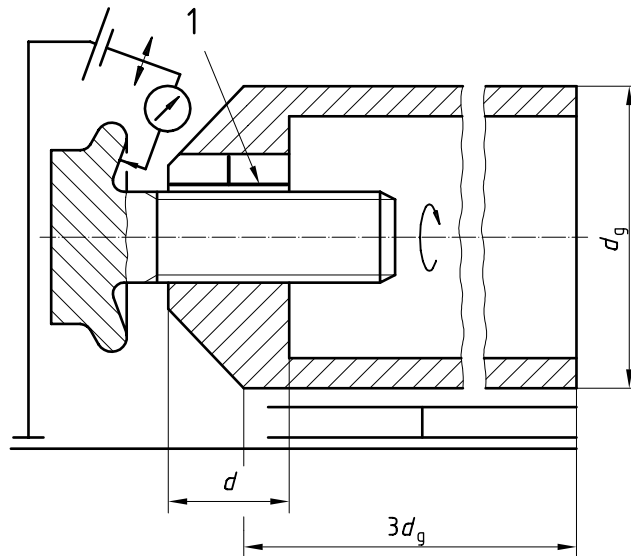
- 1 Three jaw chuck

**Figure C.14 — measuring device for verifying perpendicularity (total run-out) specified in Figures 51, 52, 53, 55, 102 and 103**

**Key**

- 1 Three jaw chuck  
2 Straight edge anvil

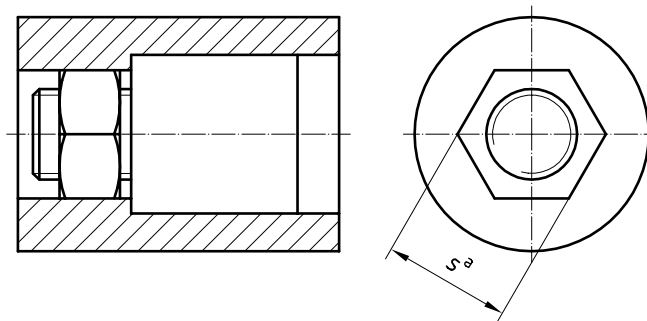
**Figure C.15 — Measuring device for verifying perpendicularity (total run-out) specified in Figure 54**



**Key**

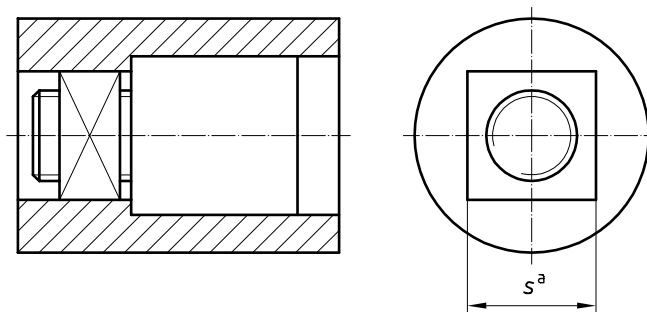
- 1 Three jaw chuck

**Figure C.16 — Measuring device for verifying permissible deviation from the form of bearing face specified in Figure 57**



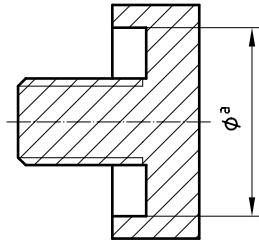
- a Maximum material size +  $t$ .

**Figure C.17 — Gauge for verifying position tolerance specified in Figures 73 and 74**



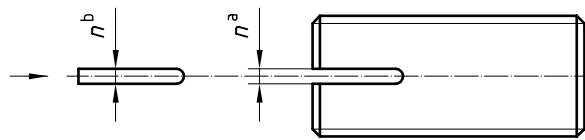
- a Max. mat. size +  $t$ .

**Figure C.18 — Gauge for verifying position tolerance specified in Figure 75**



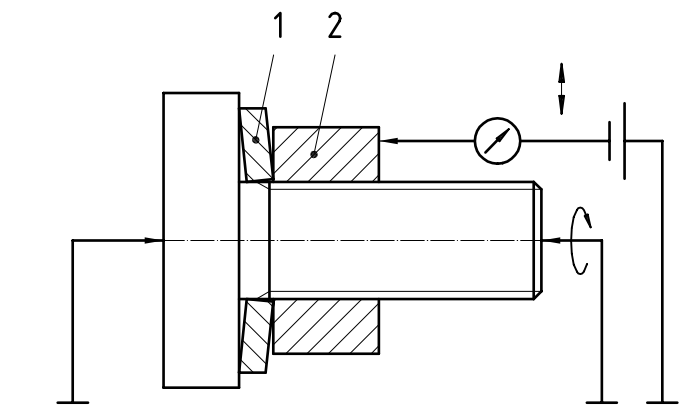
- a Max. mat. size +  $t$ .

**Figure C.19 — Gauge for verifying position tolerance specified in Figures 76 and 78**



- a Max. mat. size.  
b Max. mat. size -  $t$ .

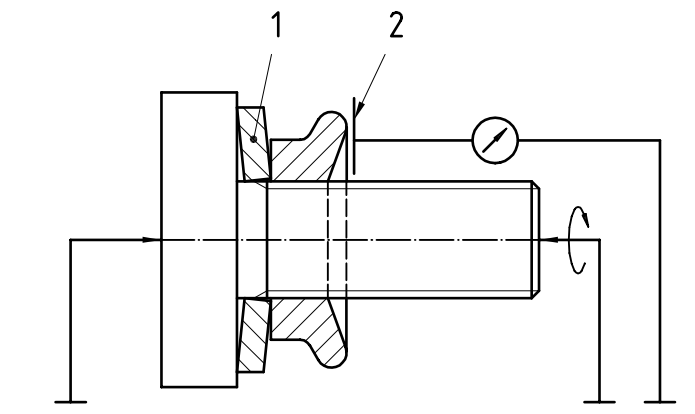
**Figure C.20 — Gauge for verifying position tolerance specified in Figure 77**



**Key**

- 1 Gauge conical spring washer  
2 Fastener

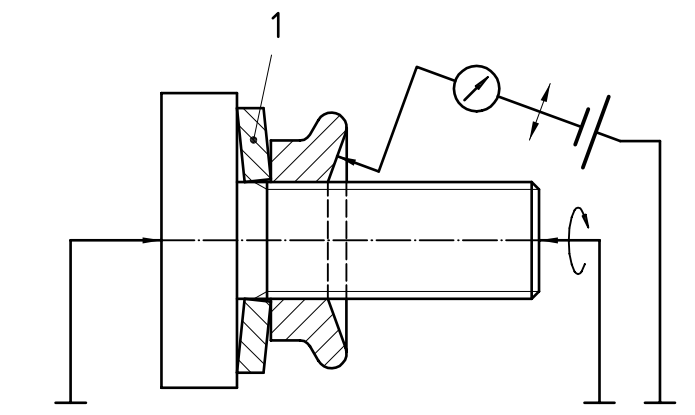
**Figure C.21 — measuring device for verifying perpendicularity (total run-out) specified in Figures 79, 80 and 81**



**Key**

- 1 Gauge conical spring washer
- 2 Straight edge anvil

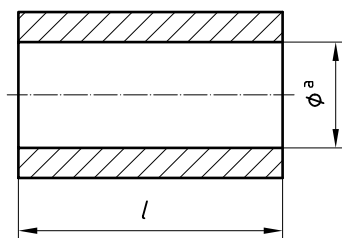
**Figure C.22 — Measuring device for verifying perpendicularity (total run-out) specified in Figure 82**



**Key**

- 1 Gauge conical spring washer

**Figure C.23 — Measuring device for verifying permissible deviation from the form of bearing face specified in Figure 83**



- <sup>a</sup> Maximum material size +  $t$ .

**Figure C.24 — Gauge for verifying straightness specified in Figures 47, 48, 49, 50 and 104**



