# INTERNATIONAL STANDARD

**ISO 1302**

Third edition
1992-11-01

# Technical drawings — Method of indicating surface texture

*Dessins techniques — Indication des états de surface*



Reference number
ISO 1302:1992(E)

## 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.

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.

International Standard ISO 1302 was prepared by Technical Committee ISO/TC 10, *Technical drawings, product definition and related documentation*.

This third edition cancels and replaces the second edition (ISO 1302:1978), of which it constitutes a technical revision.

Annex A forms an integral part of this International Standard. Annexes B, C, D and E are for information only.





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# Technical drawings — Method of indicating surface texture

## 1 Scope

This International Standard specifies graphical symbols and additional indications of surface texture to be used on technical drawings. It should not be taken as prescribing rules for the choice of surface roughness parameters suitable in any given case.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 468:1982, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 3461-2:1987, *General principles for the creation of graphical symbols — Part 2: Graphical symbols for use in technical product documentation.*

ISO 4287-1:—[1], *Surface roughness — Terminology — Part 1: Surface and its parameters.*

ISO 4288:1985, *Rules and procedures for the measurement of surface roughness using stylus instruments.*

ISO 10135-1:—[2], *Technical drawings — Representation of parts produced by shaping processes — Part 1: Moulded parts.*

ISO 10209-1:1992, *Technical product documentation — Vocabulary — Part 1: Terms relating to technical drawings: general and types of drawings.*

1) To be published. (Revision of ISO 4287-1:1984)

2) To be published.

## 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 10209-1 and ISO 4287-1 apply.

## 4 Graphical symbols for indication of surface texture

**4.1** The basic graphical symbol consists of two straight lines of unequal length inclined at approximately 60° to the line representing the considered surface, as shown in figure 1.

This graphical symbol in isolation means "the surface under consideration" and prescribes no requirement for surface roughness.

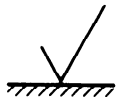


**Figure 1**

**4.2** If the removal of material by machining is required, a bar shall be added to the basic graphical symbol, as shown in figure 2.

**Figure 2**

This graphical symbol in isolation means "a surface to be machined" and prescribes no requirement for surface roughness.

**4.3** If the removal of material is not permitted, a circle shall be added to the basic graphical symbol, as shown in figure 3.

**Figure 3**

**4.4** The graphical symbol shown in figure 3 may also be used in a drawing relating to a production process to indicate that a surface is to be left in the state resulting from a preceding manufacturing process, whether this state was achieved by removal of material or otherwise.

In this case, none of the indications given in clause 6 is added to the graphical symbol.

**4.5** When special surface texture characteristics have to be indicated (see 6.3) a line is added to the longer arm of any of the graphical symbols illustrated in figures 1 to 3, as shown in figure 4.

**Figure 4**

**4.6** When the same surface texture is required on all surfaces around a part, a circle is added to the graphical symbol illustrated in figure 4, as shown in figure 5.

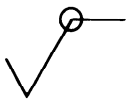


**Figure 5**

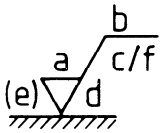
## 5 Interpretation of drawing indication of surface roughness values

The interpretation of surface roughness parameters, indicated by means of upper and/or lower limits or designated as maximum (max.) and/or minimum (min.) values respectively, for the purposes of inspection of the surface finish of a workpiece is described in ISO 4288.

## 6 Indication of surface texture

### 6.1 Indications added to the graphical symbols

The indications of surface texture shall be placed relative to the graphical symbol as shown in figure 6.




**Key**

a roughness value(s), $R_a$, in micrometres, preceded by the parameter symbol Ra (see 6.2.1), or other roughness parameter symbol(s) together with its (their) value(s), in micrometres (see note 1 to 6.2.1)

b production method, treatment, coating or other requirements concerning the production process, etc.

c waviness height, in micrometres, preceded by the corresponding parameter symbol, or sampling length, in millimetres (for $R_a$, $R_y$ or $R_z$ this value shall be omitted when it is that given in ISO 4288)

d surface pattern (see 6.4)

e machining allowance (see ISO 10135-1)

f roughness value(s) other than $R_a$, in micrometres, preceded by the parameter symbol (e.g. Ry 0,4) (see note 1 to 6.2.1)

**Figure 6**

## 6.2 Indication of surface roughness/waviness

**6.2.1** The value or values of the arithmetical mean deviation $R_a$ are added to the graphical symbols given in figures 1 to 3 as shown in figures 7 to 9.

NOTE 1 In accordance with 6.1, this edition of this International Standard permits the indication of roughness values other than $R_a$ in area "a" or "f". In a future edition of this International Standard, all roughness values will be placed in area "a", each preceded by the corresponding roughness parameter symbol.


**Figure 7**


**Figure 8**


**Figure 9**

The interpretations of the indications in figures 7 to 9 are as follows. The surface texture specified in figure 7 may be obtained by any production method (removal of material by machining is optional) (see 4.1), that specified in figure 8 shall be obtained by removal of material by machining (obligatory) (see 4.2), and that specified in figure 9 shall be obtained by a procedure other than removal of material (see 4.3).

**6.2.2** When only one value is specified it constitutes the upper limit of the surface roughness parameter.

**6.2.3** If it is necessary to specify upper and lower limits of the roughness parameter, both values shall be given as illustrated in figure 10, with the upper limit $a_1$ above the lower limit $a_2$.

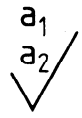



**Figure 10**

**6.2.4** Preferred numerical values for surface roughness parameters (maximum and/or minimum values, upper and/or lower limits, or a range of values) shall be selected from ISO 468.

**6.2.5** If it is necessary to specify waviness height[3], this shall be indicated under a line added to the longer arm of the symbols given in figures 1 to 3, as shown in figure 11.

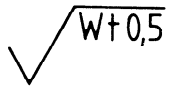



**Figure 11**

## 6.3 Indication of special surface texture characteristics

**6.3.1** In certain circumstances, for functional reasons, it may be necessary to specify additional special requirements concerning surface texture.

**6.3.2** When the required surface texture is to be produced by a particular method, that method shall be indicated in words on a line added to the longer arm of the symbols given in figures 1 to 3, as shown in figure 12.

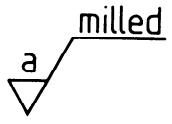



**Figure 12**

3) An International Standard dealing with rules for preferred values as well as rules for measurement procedures is under consideration by ISO/TC 57.

**6.3.3** Any indications relating to treatment or coatings shall also be given on this line.

Unless otherwise stated, the numerical value of the roughness applies to the surface texture after treatment or coating.

If it is necessary to define surface texture both before and after treatment, this shall be explained in a note or in accordance with figure 13.

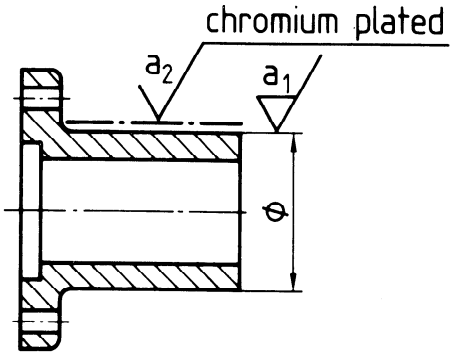



**Figure 13**

**6.3.4** If it is necessary to indicate the sampling length, this shall be selected from the appropriate series given in ISO 4288 and stated, in millimetres, adjacent to the graphical symbol, as shown in figure 14.

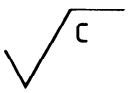



**Figure 14**

## 6.4 Graphical symbols for the surface pattern

**6.4.1** If it is necessary to specify the surface pattern by working (e.g. tool marks) and, in particular, the direction of lay, the appropriate graphical symbol shall be added to the surface texture symbol, as shown for example in figure 15.

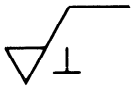


**Figure 15**

NOTE 2 The direction of lay is the direction of the predominant surface pattern, usually determined by the production method employed.

**6.4.2** The graphical symbols for the common surface patterns are specified in table 1.

## 7 Indications on drawings

(See also the examples given in annex D.)

**7.1** The general rule is that the graphical symbol together with the associated inscriptions shall be oriented so that they can be read from the bottom or the right-hand side of the drawing, in conformity with ISO 129[1] (see figure 16).

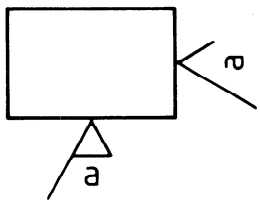
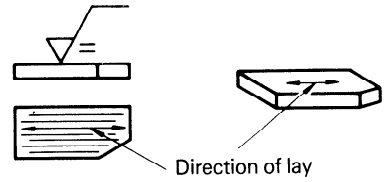
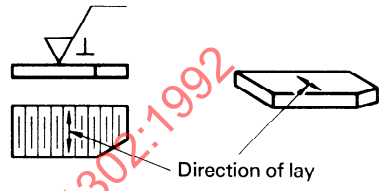
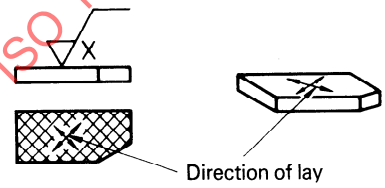
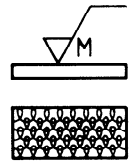
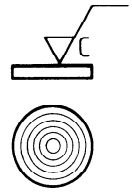
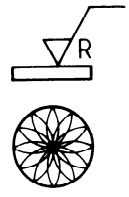
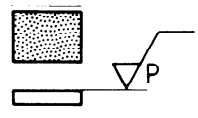



**Figure 16**

However, if it is not practicable to adopt this general rule, the graphical symbol may be drawn in any position, but only if it does not carry any indications of special surface texture characteristics. Nevertheless, in such cases, the inscription defining the value of the arithmetical mean deviation $R_a$ (if present) shall always be written in conformity with the general rule (see figure 16).

If necessary, the graphical symbol may be connected to the surface by a leader line terminating in an arrowhead.

**Table 1**

| Graphical symbol | Interpretation and example |
|---|---|
| = | Parallel to the plane of projection of the view in which the symbol is used   |
| ⊥ | Perpendicular to the plane of projection of the view in which the symbol is used   |
| X | Crossed in two oblique directions relative to the plane of projection of the view in which the symbol is used   |
| M | Multi-directional   |
| C | Approximately circular relative to the centre of the surface to which the symbol applies   |
| R | Approximately radial relative to the centre of the surface to which the symbol applies   |
| P | Lay is particulate, non-directional, or protuberant   |
| NOTE — If it is necessary to specify a surface pattern which is not clearly defined by these symbols, this shall be achieved by the addition of a suitable note to the drawing. | |

As a general rule, the graphical symbol, or the leader line terminating in an arrowhead, shall point from outside the material of the piece either to the line representing the surface, or to an extension of it (see figure 17)

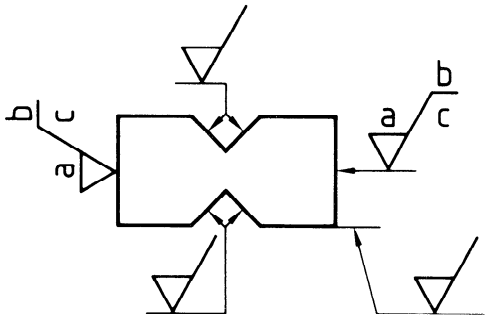



Figure 17

However, if there is no risk of misinterpretation, the surface roughness requirement may be indicated in connection with the dimensions given, as shown in figure 18.

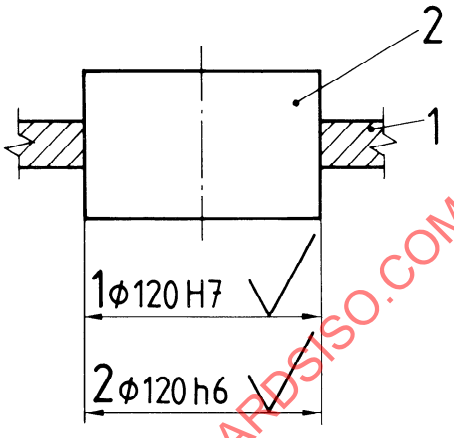



Figure 18

**7.2** The graphical symbol shall be used only once for a given surface and, if possible, on the same view as the dimensions defining the size or position of the surface. Cylindrical as well as prismatic surfaces need only be specified once if indicated by a centreline (see figure 19). However, each prismatic surface needs to be indicated separately if a different surface texture is required or if particular requirements are applicable (see figure 20).

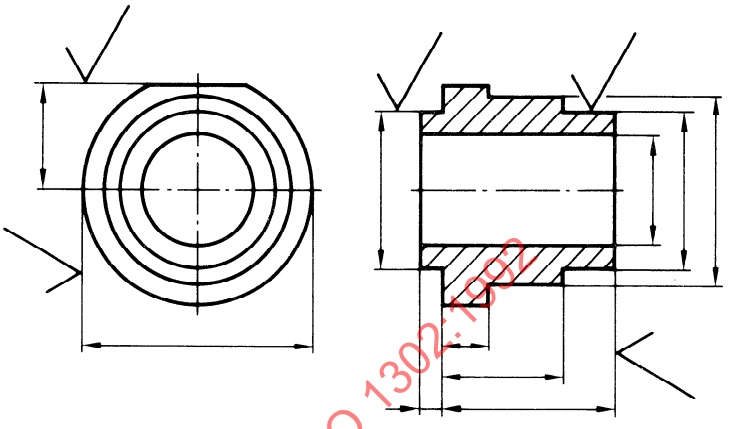


Figure 19

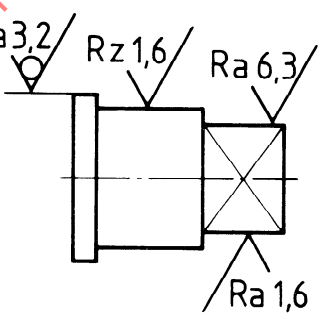



Figure 20

**7.3** If the same surface texture is required on the majority of the surfaces of a part, the general graphical symbol corresponding to this surface texture shall be followed by

— a basic graphical symbol in parentheses without any other indication (see figure 21), or

— the graphical symbol or symbols in parentheses of the special surface texture or textures (see figure 22).

Symbols for surface textures which are exceptions to the general symbol shall be indicated on the corresponding surfaces.

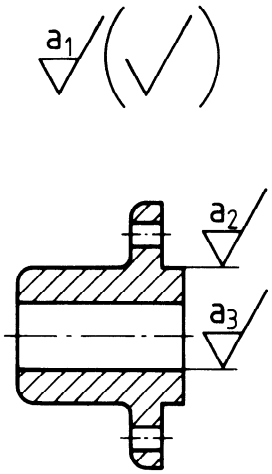



Figure 21

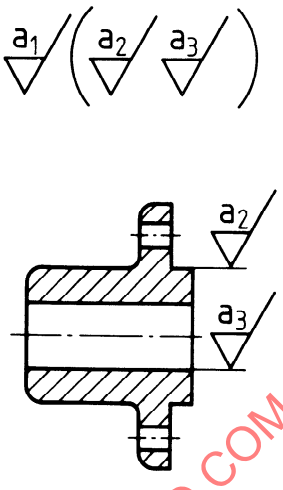



Figure 22

**7.4** To avoid the necessity of repeating a complicated indication a number of times, or where space is limited, a simplified indication may be used on the surface provided that its meaning is explained near the part in question, near the title block or in the space devoted to general notes (see figure 23).

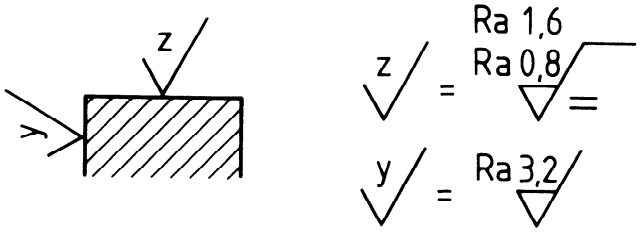



Figure 23

**7.5** If the same surface texture is required on a large number of surfaces of the part, the corresponding graphical symbol shown in figure 1, 2 or 3 may be used on the appropriate surface and its meaning given on the drawing as shown, for example, in figures 24 to 26.

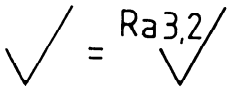



Figure 24

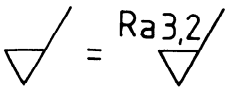



Figure 25

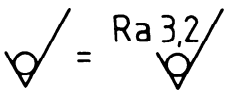



Figure 26

# Annex A
(normative)

# Proportions and dimensions of graphical symbols

## A.1 General requirements

In order to harmonize the size of the symbols specified in this International Standard with those of the other inscriptions on technical drawings (dimensions, tolerances, etc.) the rules given in ISO 3461-2 shall be applied.

## A.2 Proportions

The basic symbol and its complements (see clause 4) shall be drawn in accordance with figures A.1 to A.3.

The shape of the symbols in figures A.2 c) to A.2 g) is the same as that of the corresponding capital letters in ISO 3098-1[2] (lettering B vertical).

For dimensions, see A.3.

The length of the horizontal stroke of the symbol in figure A.1 b) depends on the indications associated with it (see 6.3 and B.3).

If one roughness value only is to be inscribed, this shall be situated in area $a_2$ shown in figure A.3.



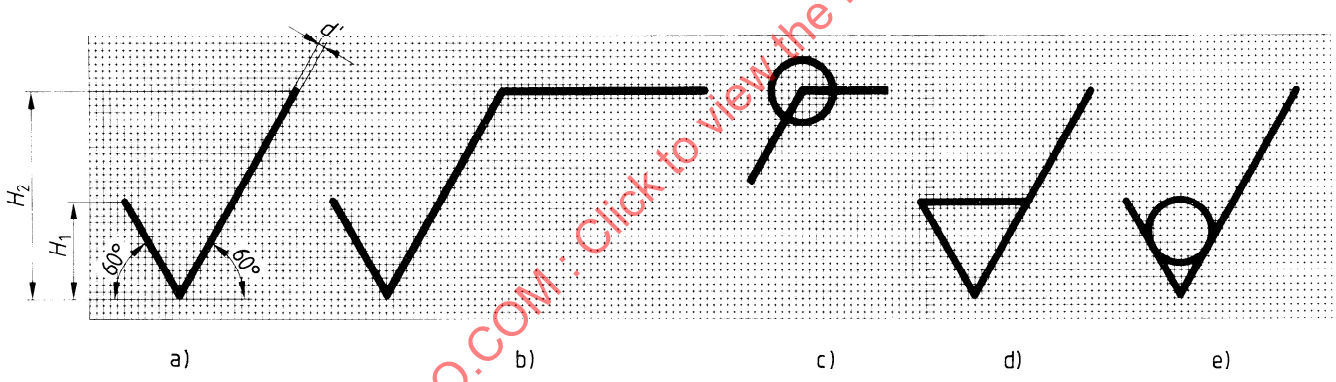



**Figure A.1**

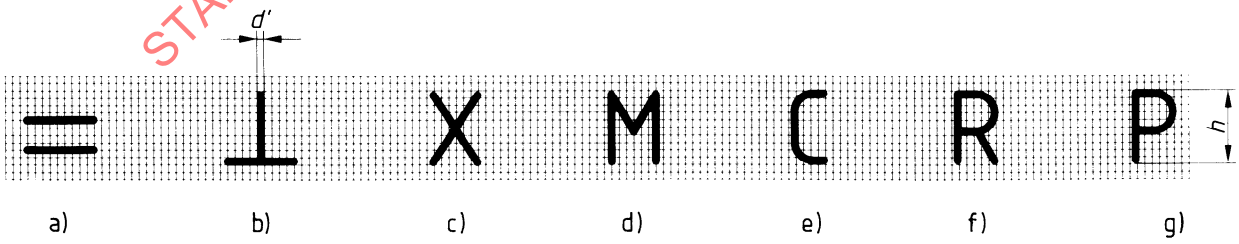
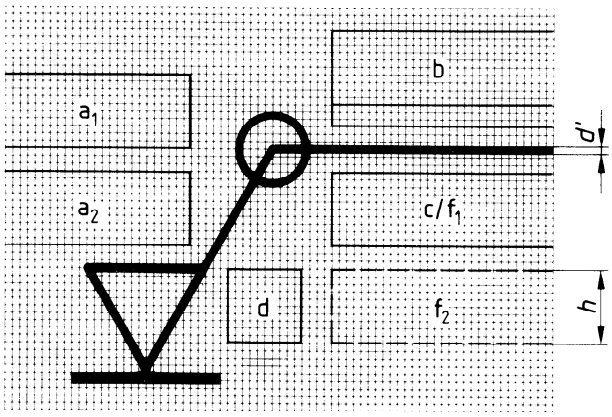



**Figure A.2**




NOTE – For the meaning of the identifying letters indicating the placing of surface texture specifications in areas a to f, see figures 6 and 10.

**Figure A.3**

The height of all lettering in areas $a_1$, $a_2$, c and d (see figure A.3) shall be equal to $h$.

As the lettering in area b, figure A.3, may comprise capital and/or lower-case letters, the height of this area may be greater than $h$ to allow for tails of lower-case letters.

The inscription of the roughness value in area $a_2$ shall be at the same level as that of the sampling length in area c (see figure A.3).

## A.3 Dimensions

The dimensions of the graphical symbols and additional indications shall be as specified in table A.1.

**Table A.1**

Dimensions in millimetres

| Height of numerals and letters, $h$ (see ISO 3098-1[2]) | 2,5 | 3,5 | 5 | 7 | 10 | 14 | 20 |
|---|---|---|---|---|---|---|---|
| Line width for symbols, $d'$ | 0,25 | 0,35 | 0,5 | 0,7 | 1 | 1,4 | 2 |
| Line width for lettering, $d$ | | | | | | | |
| Height, $H_1$ | 3,5 | 5 | 7 | 10 | 14 | 20 | 28 |
| Height, $H_2$ | 8 | 11 | 15 | 21 | 30 | 42 | 60 |

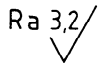
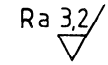
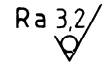
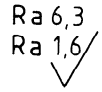
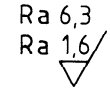
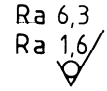
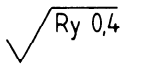
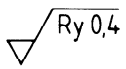
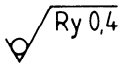
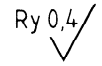
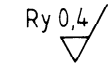
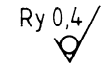
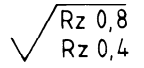
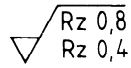
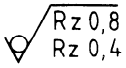
# Annex B
(informative)

# Synoptic tables

## B.1 Graphical symbols with no inscription

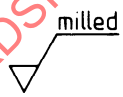
| Reference No. | Graphical symbol | Meaning |
|---|---|---|
| B.1.1 |  | Basic symbol. It may be used in isolation only when its meaning is either "the surface under consideration" or explained by a note (see 7.3 to 7.5). |
| B.1.2 |  | A machining surface with no indication of any other detail. In isolation this graphical symbol may be used only when its meaning is "a surface to be machined". |
| B.1.3 |  | A surface from which the removal of material is prohibited. This symbol may also be used in a drawing relating to a production process to indicate that a surface is to be left in the state resulting from a preceding manufacturing process, whether this state was achieved by removal of material or otherwise. |

## B.2 Graphical symbols with indication of surface texture

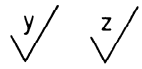
| Reference No. | Graphical symbol | | | Meaning |
|---|---|---|---|---|
| | Removal of material by machining is optional | obligatory | prohibited | |
| B.2.1 |  |  |  | A surface with an upper limit of the surface roughness parameter $R_a$ of 3,2 µm. |
| B.2.2 |  |  |  | A surface with an upper limit of the surface roughness parameter $R_a$ of 6,3 µm and a lower limit of 1,6 µm. |
| B.2.3 |  |  |  | A surface with an upper limit of the surface roughness parameter other than $R_a$, in this case $R_y = 0,4$ µm. |
| B.2.4 |  |  |  | A surface with a surface roughness parameter other than $R_a$ (see figure 6 and the note to 6.2.1). |
| B.2.5 |  |  |  | A surface with a surface roughness parameter other than $R_a$, in this case $R_z$ with an upper limit of $R_z = 0,8$ µm and a lower limit of $R_z = 0,4$ µm. |
| NOTE 3 The surface roughness values are given as examples only. | | | | |

## B.3 Graphical symbols with additional indications

(These indications may be used in combination with the appropriate graphical symbol from B.2.)

| Reference No. | Graphical symbol | Meaning |
|---|---|---|
| B.3.1 |  | Production method: milled (see 6.3.2) |
| B.3.2 |  | Sampling length: 2,5 mm (see 6.3.4) |
| B.3.3 |  | Surface pattern: direction of lay perpendicular to the plane of projection of the view (see 6.4) |
| NOTE 4 The production method, sampling length and surface pattern quoted are given as examples only. | | |

## B.4 Simplified graphical symbols

| Reference No. | Graphical symbol | Meaning |
|---|---|---|
| B.4.1 |  | The meaning is defined by text added to the drawing (see 7.4 and 7.5) |
| B.4.2 |   | |

# Annex C
(informative)

## Comparison of arithmetical mean deviation $R_a$ and roughness grade numbers

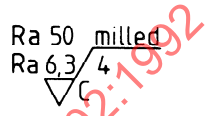
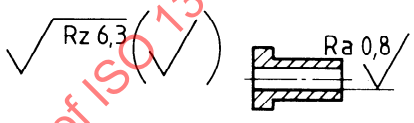
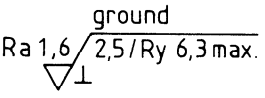
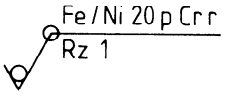
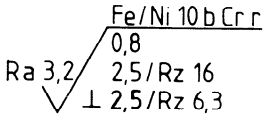
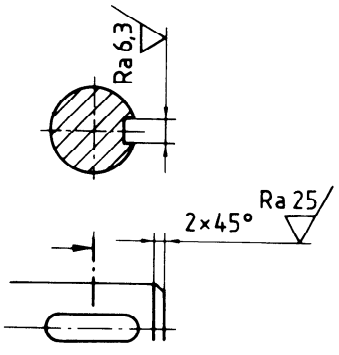
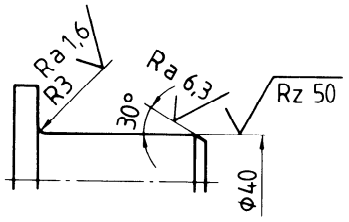
In order to avoid misinterpretation of numerical values and roughness grade numbers in drawings which are not yet in accordance with this edition of ISO 1302 the information given in the previous edition of ISO 1302 is reproduced in table C.1.

**Table C.1**

| Roughness values $R_a$ | | Roughness grade numbers (given in the previous edition of ISO 1302) |
|---|---|---|
| µm | µin | |
| 50 | 2 000 | N12 |
| 25 | 1 000 | N11 |
| 12,5 | 500 | N10 |
| 6,3 | 250 | N9 |
| 3,2 | 125 | N8 |
| 1,6 | 63 | N7 |
| 0,8 | 32 | N6 |
| 0,4 | 16 | N5 |
| 0,2 | 8 | N4 |
| 0,1 | 4 | N3 |
| 0,05 | 2 | N2 |
| 0,025 | 1 | N1 |

# Annex D
(informative)

## Examples

| Reference No. | Requirement | Example |
|---|---|---|
| D.1 | Surface roughness between $R_a = 50$ µm and $R_a = 6{,}3$ µm; direction of lay approximately circular relative to the centre; production process, milled; sampling length 4 mm |   |
| D.2 | Surface roughness $R_z = 6{,}3$ µm on all surfaces except for one surface which has a surface roughness $R_a = 0{,}8$ µm |   |
| D.3 | Surface texture produced by grinding; $R_a = 1{,}6$ µm limited to $R_y$ max. = 6,3 µm; sampling length 2,5 mm; direction of lay approximately perpendicular to the plane of projection |   |
| D.4 | Surface treatment without any machining; nickel/chrome plated; roughness $R_z = 1$ µm on all surfaces |   |
| D.5 | Surface treatment, electroplated nickel/chrome coating; surface texture $R_a = 3{,}2$ µm with a sampling length of 0,8 µm, limited to an $R_z$ value between $R_z = 16$ µm and $R_z = 6{,}3$ µm with a sampling length of 2,5 mm; direction of lay approximately perpendicular to the plane of projection |   |
| D.6 | Indication for surface texture and dimensioning may be combined by using the same dimension line |   |
| D.7 | Surface texture and dimensioning may be indicated<br>— together on an extended dimension line, or<br>— separated on the respective projection line and dimension line |   |