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**Hydraulic fluid power — Cylinders —  
Dimensions and tolerances of housings  
for single-acting piston and rod seals in  
reciprocating applications**

*Transmissions hydrauliques — Vérins — Dimensions et tolérances des  
logements de joints d'étanchéité pour pistons et tiges de piston à simple  
effet dans les applications à mouvement alternatif*

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## Foreword

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

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

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

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

ISO 5597 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 7, *Sealing devices*.

This second edition cancels and replaces the first edition (ISO 5597:1987), which has been technically revised.

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## Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Sealing devices are used to contain the pressurized fluid with components having elements with linear motion, i.e. hydraulic cylinders. These sealing devices are used with both cylinder rod and piston seal housings.

This International Standard is one of a series of standards covering dimensions and tolerances of housings.

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# Hydraulic fluid power — Cylinders — Dimensions and tolerances of housings for single-acting piston and rod seals in reciprocating applications

## 1 Scope

This International Standard establishes the preferred range of nominal dimensions and associated tolerances for a series of hydraulic cylinder rod and piston seal housings for reciprocating applications in the following range of dimensions:

- cylinders from 16 mm to 500 mm;
- rods from 6 mm to 360 mm.

An additional range of seal housings is detailed in this International Standard to meet the reduced envelope requirements of the 160 bar (16 MPa)<sup>1)</sup> compact series of ISO 6020-2; these smaller section seals require stricter piston rod and cylinder bore tolerances. The range of dimensions is as follows:

- a) cylinders from 25 mm to 200 mm;
- b) rods from 12 mm to 140 mm.

This International Standard does not give details of seal design, since the manner of construction of seals varies with each manufacturer. The design and material of the seal and any incorporated anti-extrusion component are determined by conditions such as temperature and pressure.

This International Standard only applies to the dimensional criteria of products manufactured in conformity with this International Standard; it does not apply to their functional characteristics.

## 2 Normative references

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

ISO 883, *Indexable hardmetal (carbide) inserts with rounded corners, without fixing hole — Dimensions*

ISO 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

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1) 1 bar = 100 kPa = 10<sup>5</sup> Pa = 0,1 MPa; 1 Pa = 1 N/m<sup>2</sup>.

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 6020-2, *Hydraulic fluid power — Mounting dimensions for single rod cylinders, 16 MPa (160 bar) series — Part 2: Compact series*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 apply.

### 4 Letter symbols

Letter symbols used in this International Standard are as follows:

- a* roughness of the side surface of the seal housing
- b* roughness of the static pressure mating surface of the seal housing
- C* axial length of the lead-in chamfer
- C*<sub>0</sub> reference material ratio level (see ISO 4287:1997, 4.5)
- d* inside diameter (rod diameter) of the seal housing
- e* roughness of dynamic pressure mating surface
- f* surface roughness of lead-in chamfer
- D* outside diameter (bore diameter) of the seal housing
- d*<sub>3</sub> clearance diameter of the piston
- d*<sub>4</sub> clearance diameter of the rod seal housing
- d*<sub>5</sub> clearance diameter of the rod
- L* axial length (seal groove length) of the seal housing
- Rδc* profile section height difference (see ISO 4287:1997, 4.5.3)
- S*  $\frac{D-d}{2}$ ; radial depth (cross-section) of the seal housing
- r* radius
- W, X* reference surface
- V, Y* maximum run-out tolerance

## 5 Seal housings

### 5.1 General

**5.1.1** Illustrated examples of typical hydraulic cylinder rod and piston seal housings covered by this International Standard are given in Figures 1 to 4.

NOTE These figures are diagrammatic only and do not represent recommendations of a particular housing design.

**5.1.2** All sharp edges and burrs shall be removed from corners of supporting surfaces and rounded, although it should be borne in mind that these surfaces are required to provide maximum support against extrusion.

**5.1.3** The seal manufacturer shall be consulted for details of housing design that are not specified in this International Standard.

### 5.2 Axial length

The short axial length,  $L$ , as given in Tables 3 and 5, shall be adopted only after consultation with the manufacturer.

Consultation with the manufacturer is recommended when making the appropriate selection from the available choices.

NOTE This International Standard includes a choice of axial length for every nominal piston and rod diameter, the exception being cylinders conforming to ISO 6020-2, in which case only one length is provided (see Clause 1 and Tables 4 and 6).

### 5.3 Radial depth

The larger radial depth (cross-section),  $S$ , of the seal housing shall be chosen where higher stresses or wider tolerances are involved.

Consultation with the manufacturer is recommended when making the appropriate selection from the available choices.

NOTE This International Standard includes an alternative seal housing radial depth (cross-section) for most piston and rod diameters, the exception being at the upper and lower extremities of the diameter range as well as cylinder seal housings conforming to ISO 6020-2, in which case only one radial depth is provided.

## 6 Dimensions and tolerances

NOTE See ISO 4394-1 and ISO 3320.

### 6.1 Piston seal housing dimensions

**6.1.1** Illustrated examples of piston seal housing dimensions are given in Figures 1 and 2.

**6.1.2** Piston seal housing dimensions (except in the case of cylinders conforming to ISO 6020-2) shall be selected from Table 3.

**6.1.3** Piston seal housing dimensions for use with cylinders conforming to ISO 6020-2 shall be selected from Table 4.

## 6.2 Rod seal housing dimensions

6.2.1 Illustrated examples of rod seal housing dimensions are given in Figures 3 and 4.

6.2.2 Rod seal housing dimensions (except in the case of cylinders conforming to ISO 6020-2) shall be selected from Table 5.

6.2.3 Rod seal housing dimensions for use with cylinders conforming to ISO 6020-2 shall be selected from Table 6.

## 6.3 Radial seal space tolerances

6.3.1 Reference shall be made to Table 7 for radial seal space tolerances.

6.3.2 Reference shall be made to Notes 1 and 2 of Table 7 for the equations for calculating tolerances on  $d$  (see Figures 1 and 2) and  $D$  (see Figures 3 and 4).

NOTE 1 Generally, the equations and values shown in Table 7, when used in conjunction with the ISO 286-2 limits for  $D$  H9 and  $d_3$  f8 (for the piston case) or  $d$  f8 and  $d_5$  H9 (for the rod case), in most cases result in tolerances within the range of  $d$  h10 and  $D$  H10, respectively.

NOTE 2 If alternative limits to those given in Note 1 are selected for  $D$  and  $d_3$  (for the piston case) or  $d$  and  $d_5$  (for the rod case), then the use of the equations maintains the necessary radial seal space limits, i.e. any relaxation of tolerance on one housing diameter is compensated by a tighter tolerance on the other diameter.

## 6.4 Housing length

A tolerance of  ${}^{+0,25}_0$  mm shall be used on the length of the housing.

## 7 Extrusion gap

The extrusion gap is determined by the diameter ( $d_4$  or  $d_3$ ) of the adjacent metal components behind the seal. It is recommended that details concerning  $d_3$  (see Figures 1 and 2) and  $d_4$  (see Figures 3 and 4) be subject to consultations between the housing designer and seal manufacturer.

NOTE 1 Maximum value for the extrusion gap is achieved when the piston or piston rod is in contact with one side of the cylinder or bearing.

NOTE 2 The extrusion gap for piston seals is further widened by the expansion of the cylinder due to internal pressure.

## 8 Surface roughness

### 8.1 General statement

The surface roughness of the seal housing and any mating part has a significant impact on the life and sealing performance of the seal.

Where surface roughness measurements are taken, it is recommended that instruments complying with ISO 3274, including an electric wave filter, be used.

### 8.2 Sliding and static sealing surfaces

8.2.1 Unless otherwise agreed, the roughness values shall be in accordance with Table 1.

**8.2.2** Unless otherwise agreed, the material ratio,  $Rmr$ , of housing surfaces that are in mating contact with the seal should be between 50 % and 80 % at a profile section level,  $R\delta_c$ , of 25 % of  $Rz$ , from a reference level of 5 % material ratio,  $C_0$  (see ISO 4287:1997, 4.5).

**8.2.3** For some seal designs, a minimum surface roughness of 0,1  $\mu m$   $Ra$  can be required for the sliding sealing surface, as otherwise the surface can be too smooth to provide adequate lubrication for the seal.

**8.2.4** Exceptional service conditions can necessitate the selection of other grades of surface roughness, in which case they should be subject to agreement between manufacturer and user.

**8.2.5** All surfaces against which a seal operates should be free from chatter marks and scores along the operating axis of the seal.

**Table 1 — Surface roughness requirements for piston and rod housings<sup>a</sup>**

Dimensions in micrometres unless otherwise specified

| Radial depth of seal housing<br>$S$<br>mm   | Surface roughness values <sup>bcd</sup>             |  |                          |   | Minimum required measuring length<br>mm<br>(five times single measuring length plus two times cut off) |
|---|---|--|--------------------------|---|--|
|   | Dynamic pressure mating surface <sup>e</sup><br>$e$ | Static pressure mating surface <sup>e</sup><br>$b$ | Side surface<br>$a$      | Chamfer<br>$f$  |  |
| < 7,5   | $Ra$ 0,4<br>$Rz$ 1,6                                | $Ra$ 1,6<br>$Rz$ 6,3                               | $Ra$ 4 1,6<br>$Rz$ 4 6,3 | $Ra$ 4 visual inspection<br>or<br>$Rz$ 16 visual inspection | 5,6  |
| $\geq$ 7,5  |   |  | $Ra$ 1,6<br>$Rz$ 6,3     |   |  |
| <p><sup>a</sup> Indication of surface roughness is taken from ISO 1302.</p> <p><sup>b</sup> See also Figures 1 to 4. See ISO 13715 for design of edges and undefined shapes.</p> <p><sup>c</sup> The descriptions of <math>Ra</math>4 1,6 or <math>Rz</math>4 6,3 do not describe a surface roughness of <math>Ra</math> 41,6 or <math>Rz</math> 46,3. According to ISO 1302 and ISO 4288, they show four sampling lengths; they also show that the roughness does not exceed 1,6 <math>\mu m</math> for <math>Ra</math> and 6,3 <math>\mu m</math> for <math>Rz</math>. A value of <math>Ra</math> 1,6 or <math>Rz</math> 6,3 can be measured only if the length being measured is longer than 5,6 mm.</p> <p><sup>d</sup> Special applications can require different surface roughness values.</p> <p><sup>e</sup> Visual surface imperfections are not allowed on surfaces <math>b</math> and <math>e</math> (see ISO 8785).</p> |   |  |                          |   |  |

**9 Lead-in chamfer**

**9.1** Reference shall be made to Figures 1 to 4 for the location of the lead-in chamfer,  $C$ .

**9.2** The chamfer shall make an angle of between 20° and 30° with the axis.

**9.3** The length of the chamfer shall not be less than that given in Table 2.

**Table 2 — Lead-in chamfer**

Dimensions in millimetres

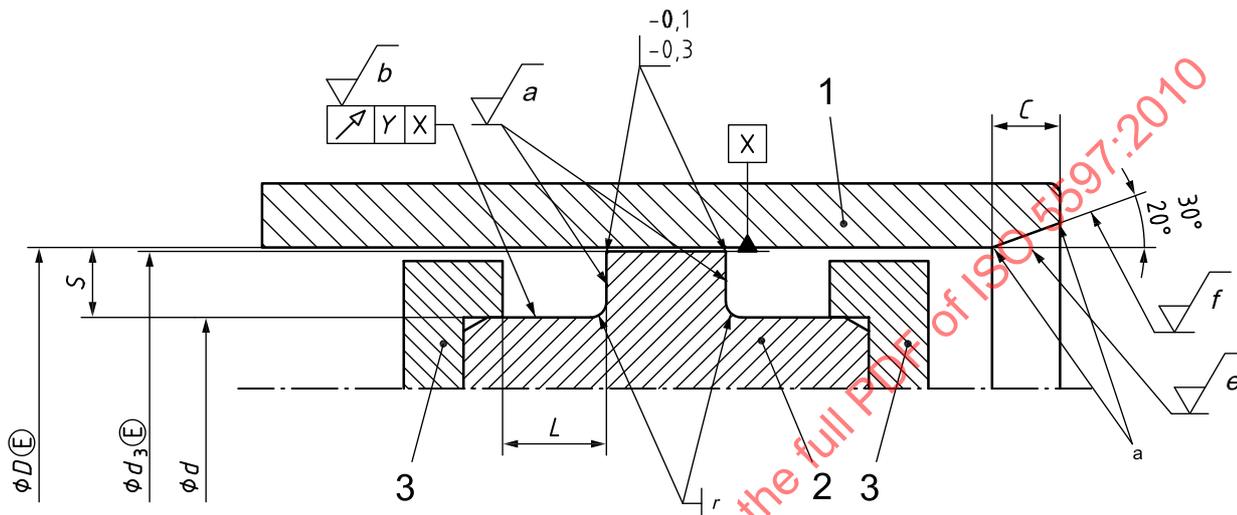
| Radial depth of seal housing, $S$            | 3,5 | 4 | 5   | 7,5 | 10 | 12,5 | 15  | 20 |
|--|-----|---|-----|-----|----|------|-----|----|
| Minimum axial length of lead-in chamfer, $C$ | 2   | 2 | 2,5 | 4   | 5  | 6,5  | 7,5 | 10 |

**10 Identification statement** (reference to this International Standard)

It is strongly recommended to manufacturers who have chosen to conform to this International Standard that the following statement be used in test reports, catalogues and sales literature.

“Dimensions and tolerances for hydraulic cylinder rod and piston seal housings selected in accordance with ISO 5597, *Hydraulic fluid power — Cylinders — Dimensions and tolerances of housings for single-acting piston and rod seals in reciprocating applications.*”

Dimensions in millimetres unless otherwise specified



**Key**

- 1 bore
- 2 piston
- 3 seal-retaining plate

a Rounded and burr-free.

NOTE 1 Maximum run-out tolerance  $Y = 0,05$ .

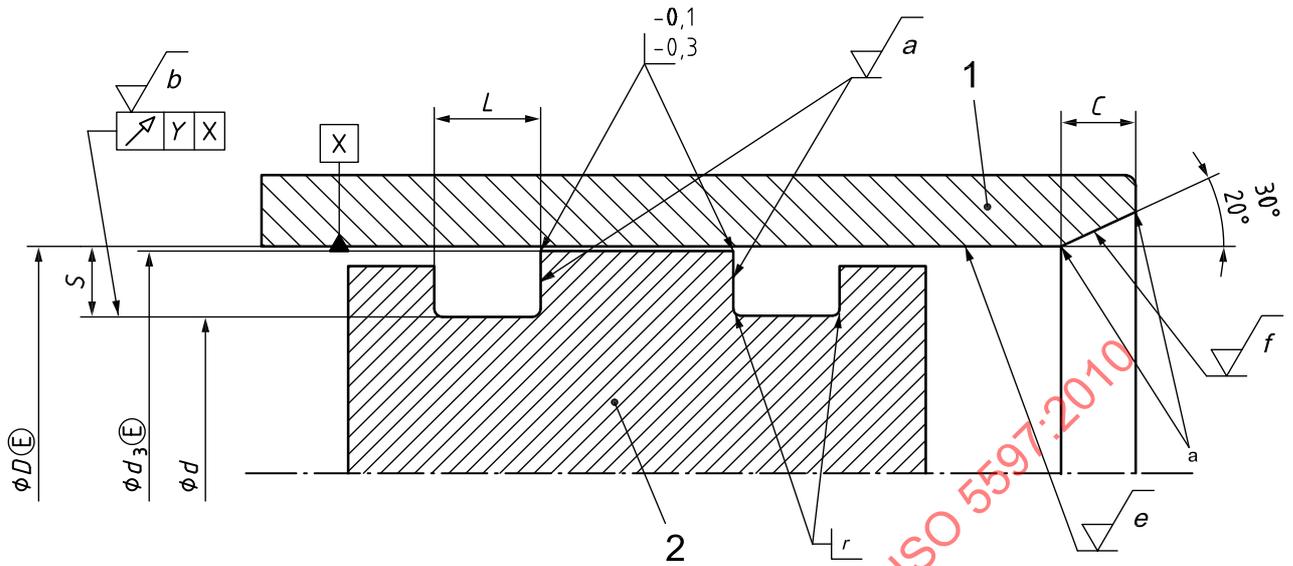
NOTE 2 See Table 1 for values of  $a$ ,  $b$ ,  $e$  and  $f$ .

NOTE 3 See Table 2 for values of  $C$ .

NOTE 4 See Table 3 for values of  $d$ ,  $D$ ,  $S$ ,  $L$  and  $r$ .

**Figure 1 — Example of piston seal housing**  
(except in the case of cylinders conforming to ISO 6020-2 — See Figure 2)

Dimensions in millimetres unless otherwise specified



**Key**

1 bore

2 piston

a Rounded and burr-free.

NOTE 1 Maximum run-out tolerance  $Y = 0,05$ .

NOTE 2 See Table 1 for values of  $a$ ,  $b$ ,  $e$  and  $f$ .

NOTE 3 See Table 2 for values of  $C$ .

NOTE 4 See Table 4 for values of  $d$ ,  $D$ ,  $S$ ,  $L$  and  $r$ .

**Figure 2 — Example of piston seal housing for use with cylinders conforming to ISO 6020-2**

**Table 3 — Nominal dimensions for piston seal housing**  
(except in the case of cylinders conforming to ISO 6020-2 — See Table 4)

Dimensions in millimetres

| Bore diameter <sup>a</sup><br><i>D</i> | Radial depth<br><i>S</i> | Inside diameter<br><i>d</i> | Axial length <sup>b</sup> |                    |      | <i>r</i><br>max. |
|--|--------------------------|-----------------------------|---------------------------|--------------------|------|------------------|
|  |                          |                             | short                     | <i>L</i><br>medium | long |                  |
| 16                                     | 4                        | 8                           | 5                         | 6,3                | —    | 0,4              |
| 20                                     |                          | 12                          |                           |                    |      |                  |
| 25                                     |                          | 17                          |                           |                    |      |                  |
| 32                                     | 5                        | 15                          | 6,3                       | 8                  | 16   |                  |
|  | 4                        | 24                          | 5                         | 6,3                | —    |                  |
| 40                                     | 5                        | 22                          | 6,3                       | 8                  | 16   |                  |
|  | 4                        | 32                          | 5                         | 6,3                | —    |                  |
| 50                                     | 5                        | 30                          | 6,3                       | 8                  | 16   |                  |
|  | 7,5                      | 40                          |                           |                    |      |                  |
| 63                                     | 5                        | 35                          | 9,5                       | 12,5               | 25   |                  |
|  | 7,5                      | 53                          | 6,3                       | 8                  | 16   |                  |
| 80                                     | 7,5                      | 48                          | 9,5                       | 12,5               | 25   |                  |
|  | 10                       | 65                          | 12,5                      | 16                 | 32   |                  |
| 90                                     | 7,5                      | 75                          |                           |                    |      | 9,5              |
| 100                                    | 10                       | 70                          | 12,5                      | 16                 | 32   |                  |
|  | 7,5                      | 85                          | 9,5                       | 12,5               | 25   |                  |
| 110                                    | 10                       | 80                          | 12,5                      | 16                 | 32   |                  |
|  | 7,5                      | 95                          | 9,5                       | 12,5               | 25   |                  |
| 125                                    | 10                       | 90                          | 12,5                      | 16                 | 32   |                  |
|  | 12,5                     | 105                         | 16                        | 20                 | 40   |                  |
| 140                                    | 10                       | 120                         |                           |                    |      | 12,5             |
| 160                                    | 12,5                     | 115                         | 16                        | 20                 | 40   |                  |
|  | 10                       | 140                         | 12,5                      | 16                 | 32   |                  |
| 180                                    | 12,5                     | 135                         | 16                        | 20                 | 40   |                  |
|  | 10                       | 160                         | 12,5                      | 16                 | 32   |                  |
| 200                                    | 12,5                     | 155                         | 16                        | 20                 | 40   |                  |
|  | 15                       | 175                         | 20                        | 25                 | 50   |                  |
| 220                                    | 12,5                     | 170                         | 20                        | 25                 | 50   |                  |
|  | 15                       | 195                         | 16                        | 20                 | 40   |                  |
| 250                                    | 15                       | 190                         | 20                        | 25                 | 50   |                  |
|  | 12,5                     | 225                         | 16                        | 20                 | 40   |                  |
| 280                                    | 15                       | 220                         | 20                        | 25                 | 50   |                  |
| 320                                    |                          | 250                         |                           |                    |      |                  |
| 360                                    |                          | 290                         |                           |                    |      |                  |
| 400                                    | 20                       | 330                         | 25                        | 32                 | 63   |                  |
| 450                                    |                          | 360                         |                           |                    |      |                  |
| 500                                    |                          | 410                         |                           |                    |      |                  |
|  |                          | 460                         |                           |                    |      | 1                |

<sup>a</sup> See ISO 3320.

<sup>b</sup> The application of the axial lengths specified in Tables 3 and 5 (short, medium and long) depends on the respective working conditions.

**Table 4 — Nominal dimensions for piston seal housings for use with cylinders conforming to ISO 6020-2**

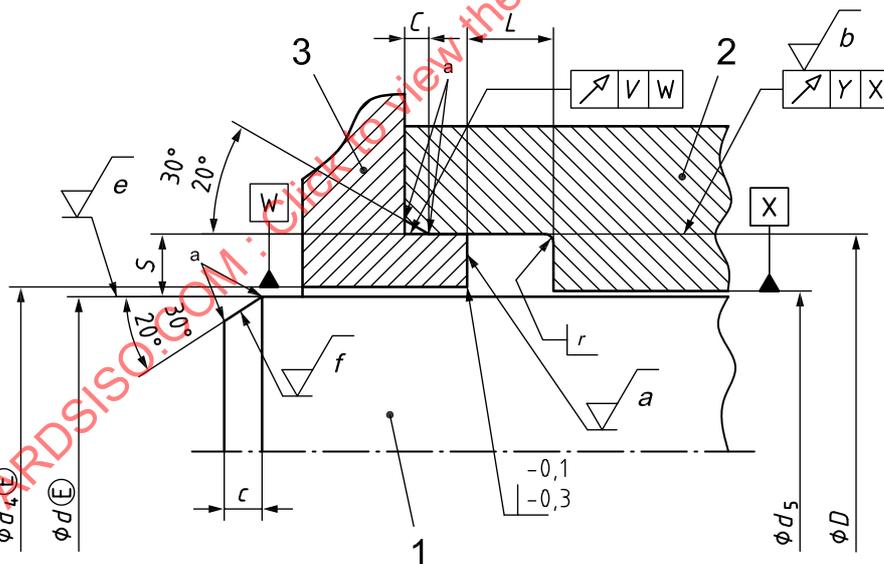
Dimensions in millimetres

| Bore diameter <sup>a</sup><br><i>D</i> | Radial depth<br><i>S</i> | Inside diameter<br><i>d</i> | Axial length<br><i>L</i> | <i>r</i> <sup>b</sup><br>max. |
|--|--------------------------|-----------------------------|--------------------------|-------------------------------|
| 25                                     | 3,5                      | 18                          | 5,6                      | 0,5                           |
| 32                                     |                          | 25                          |                          |                               |
| 40                                     | 4                        | 32                          | 6,3                      |                               |
| 50                                     |                          | 42                          |                          |                               |
| 63                                     |                          | 55                          |                          |                               |
| 80                                     | 5                        | 70                          | 7,5                      |                               |
| 100                                    |                          | 90                          |                          |                               |
| 125                                    | 7,5                      | 110                         | 10,6                     |                               |
| 160                                    |                          | 145                         |                          |                               |
| 200                                    |                          | 185                         |                          |                               |

<sup>a</sup> See ISO 6020-2.

<sup>b</sup> This specific dimension permits the use of tools conforming to ISO 883.

Dimensions in millimetres unless otherwise specified



**Key**

- 1 rod
- 2 gland
- 3 seal-retaining plate

<sup>a</sup> Rounded and burr-free.

NOTE 1 Maximum run-out tolerance *Y* = 0,05.

NOTE 2 Maximum run-out tolerance *V* = 0,05.

NOTE 3 See Table 1 for values of *a*, *b*, *e* and *f*.

NOTE 4 See Table 2 for values of *C*.

NOTE 5 See Table 5 for values of *d*, *D*, *S*, *L* and *r*.

**Figure 3 — Example of rod seal housing**  
(except in the case of cylinders conforming to ISO 6020-2 — See Figure 4)



**Table 5 — Nominal dimensions for rod seal housings**  
(except in the case of cylinders conforming to ISO 6020-2 — See Table 6)

Dimensions in millimetres

| Rod diameter <sup>a</sup><br><i>d</i> | Radial depth<br><i>S</i> | Outside diameter<br><i>D</i> | Axial length <sup>b</sup><br><i>L</i> |        |      | <i>r</i><br>max. |
|---------------------------------------|--------------------------|------------------------------|---------------------------------------|--------|------|------------------|
|                                       |                          |                              | short                                 | medium | long |                  |
| 6                                     | 4                        | 14                           | 5                                     | 6,3    | 14,5 | 0,4              |
| 8                                     |                          | 16                           |                                       |        |      |                  |
| 10                                    |                          | 18                           |                                       |        |      |                  |
| 12                                    | 5                        | 20                           | —                                     | 8      | 16   |                  |
|                                       | 4                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 14                                    | 5                        | 22                           | —                                     | 8      | 16   |                  |
|                                       | 4                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 16                                    | 4                        | 24                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 18                                    | 4                        | 26                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 20                                    | 4                        | 28                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 22                                    | 4                        | 30                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 25                                    | 4                        | 32                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 28                                    | 4                        | 33                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 5                                     | 6,3    | 14,5 |                  |
| 32                                    | 4                        | 35                           | —                                     | 8      | 16   |                  |
|                                       | 5                        |                              | 6,3                                   | 8      | 16   |                  |
| 36                                    | 7,5                      | 38                           | —                                     | 12,5   | 25   |                  |
|                                       | 5                        |                              | 43                                    | —      | 12,5 |                  |
| 40                                    | 5                        | 42                           | 6,3                                   | 8      | 16   |                  |
|                                       | 7,5                      |                              | 47                                    | —      | 12,5 |                  |
| 45                                    | 5                        | 46                           | 6,3                                   | 8      | 16   |                  |
|                                       | 7,5                      |                              | 51                                    | —      | 12,5 |                  |
| 50                                    | 5                        | 50                           | 6,3                                   | 8      | 16   |                  |
|                                       | 7,5                      |                              | 55                                    | —      | 12,5 | 25               |
| 56                                    | 5                        | 55                           | 6,3                                   | 8      | 16   |                  |
|                                       | 7,5                      |                              | 60                                    | —      | 12,5 | 25               |
| 63                                    | 5                        | 60                           | 6,3                                   | 8      | 16   |                  |
|                                       | 7,5                      |                              | 65                                    | —      | 12,5 | 25               |
| 63                                    | 7,5                      | 71                           | 9,5                                   | 12,5   | 25   |                  |
|                                       | 10                       |                              | 76                                    | —      | 16   | 32               |
| 63                                    | 7,5                      | 78                           | 9,5                                   | 12,5   | 25   | 0,4              |
|                                       | 10                       |                              | 83                                    | —      | 16   | 32               |