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Third edition
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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

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 5597:2010) which has been technically revised to ensure consistency with ISO 3320.

The main changes compared to the previous edition are:

— Seal housing sizes for a 60 mm diameter cylinder bore added to Table 3;

— 400 mm and 450 mm diameter rods added to Table 5.

— Table 1 has been modified to indicate that, for some seal housings, the axial lengths (seal groove lengths) are too short for the surface roughness to be measured with five sampling lengths.

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 document is one of a series of standards covering dimensions and tolerances of housings.

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

1 Scope

This document 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:

— for cylinders of 16 mm to 500 mm;

— for rods of 6 mm to 450 mm.

An additional range of seal housings is detailed in this document to meet the reduced envelope requirements of the 160 bar (16 MPa)[1)] 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:

— cylinders of 25 mm to 200 mm;

— rods of 12 mm to 140 mm.

This document 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 components are determined by conditions such as temperature and pressure.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

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 definitions given in ISO 5598 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

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

4 Symbols

Symbols used in this document 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

$C0$ reference material ratio level (see ISO 4287:1997, 4.5.4)

D outside diameter (bore diameter) of the seal housing

d inside diameter (rod diameter) of the seal housing

d_3 clearance diameter of the piston

d_4 clearance diameter of the rod seal housing

d_5 clearance diameter of the rod

e roughness of dynamic pressure mating surface

f surface roughness of lead-in chamfer

L axial length (seal groove length) of the seal housing

r radius

$R\delta c$ profile section height difference (see ISO 4287:1997, 4.5.3)

S $\frac{D-d}{2}$ radial depth (cross-section) of the seal housing

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 document 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 document.

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 document 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) of the seal housing, *S*, 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 document 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 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 References shall be made to NOTES 1 and 2 of Table 7 for the formulae for calculating tolerances on *d* (see Figures 1 and 2) and *D* (see Figures 3 and 4).

NOTE 1 The equations and values shown in Table 7, when used in conjunction with ISO 286-2 limits of 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 span 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 formulae will maintain the necessary radial seal space limits, i.e. any relaxation of tolerance on one housing diameter will be 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, respectively.

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

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, *C*0, of 5 % *Rmr* (in accordance with ISO 4287:1997, 4.5.4).

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

8.2.4 Exceptional service conditions may 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[a]

Dimensions in micrometres (µm) unless otherwise noted

Radial depth of seal housing *S* mm	**Surface roughness values**[b, c, d]					**Minimum required measuring length** mm (5 times single sampling length plus 2 times cut off)
	Dynamic pressure mating surface[e] *e*	**Static pressure mating surface**[e] *b*		**Side surface** *a*	**Chamfer** *f*	
		Axial length *L*				
		L ≤ 5,6	*L* > 5,6			
3,5	*Ra* 0,4 *Rz* 1,6	*Ra*4 1,6 *Rz*4 6,3	—	*Ra*2 1,6 *Rz*2 6,3	*Ra* 4 visual inspection or *Rz* 16 visual inspection	5,6
4		*Ra*4 1,6 *Rz*4 6,3	*Ra* 1,6 *Rz* 6,3			
5		—		*Ra*4 1,6 *Rz*4 6,3		
≥ 7,5				*Ra* 1,6 *Rz* 6,3		

[a] Indication of surface roughness according to ISO 1302.

[b] See also Figures 1 to 4. See ISO 13715 for design of edges and undefined shapes.

[c] The descriptions of *Ra*4 1,6 or *Rz*4 6,3 do not describe a surface roughness of *Ra* 41,6 or *Rz* 46,3. According to ISO 1302 and ISO 4288, they show four sampling lengths and the roughness does not exceed 1,6 µm for *Ra* and 6,3 µm for *Rz*.

A value of *Ra* 1,6 or *Rz* 6,3 can only be measured if the length to be measured is 5,6 mm or longer.

[d] Special applications may require different surface roughness values.

[e] Visual surface imperfections are not allowed on surfaces *b* and *e* (see ISO 8785).

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

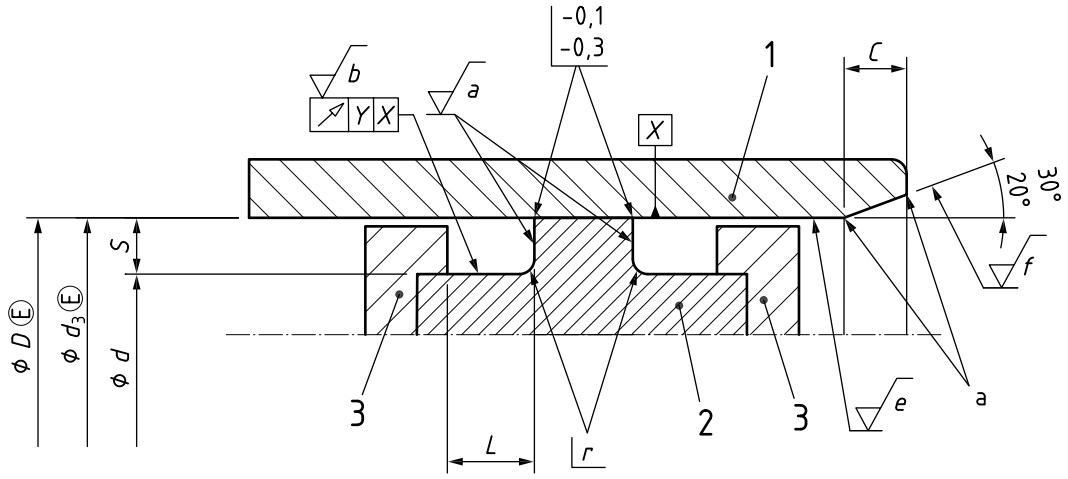
Radial depth of seal housing, *S*	3,5	4	5	7,5	10	12,5	15	20
Minimum axial length of lead in chamfer, *C*	2	2	2,5	4	5	6,5	7,5	10

10 Identification statement (reference to this document)

It is recommended that manufacturers who have chosen to conform to this document use the following statement in test reports, catalogues and sales literature:

> "Dimensions and tolerances for hydraulic cylinder rod and piston seal housings are 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



Key

1 bore
2 piston
3 seal-retaining plate
a rounded and burr-free

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

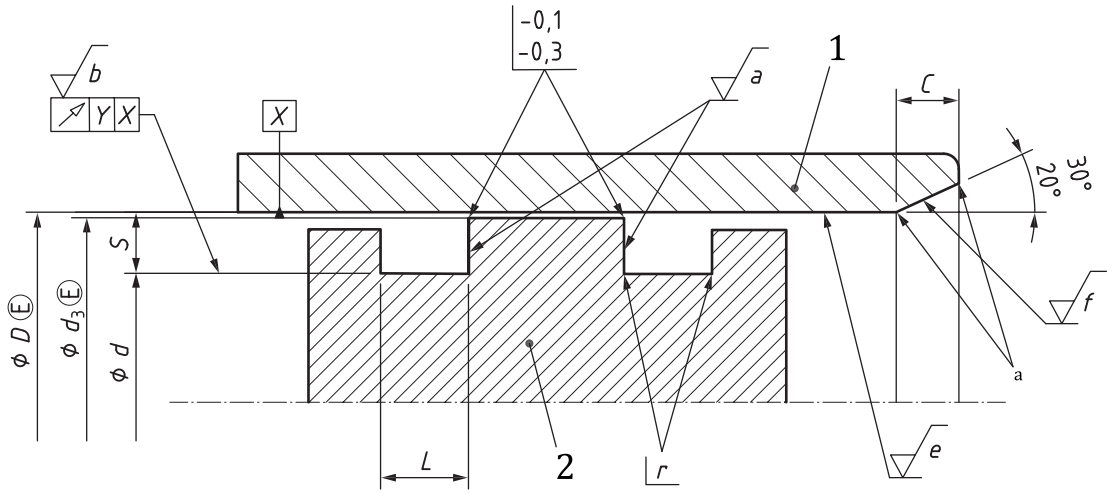
NOTE 2 See Table 1 for values of *a, b, e* and *f*.

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



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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[a] *D*	Radial depth *S*	Inside diameter *d*	Axial length[b] *L*			*r* maximum
			short	medium	long	
16	4	8	5	6,3	—	0,4
20		12				
25		17				
25	5	15	6,3	8	16	
32	4	24	5	6,3	—	
	5	22	6,3	8	16	
40	4	32	5	6,3	—	
	5	30	6,3	8	16	
50	5	40	6,3	8	16	
	7,5	35	9,5	12,5	25	
60	5	50	6,3	8	16	
	7,5	45	9,5	12,5	25	
63	5	53	6,3	8	16	
	7,5	48	9,5	12,5	25	
80	7,5	65	9,5	12,5	25	
	10	60	12,5	16	32	0,6
90	7,5	75	9,5	12,5	25	0,4
	10	70	12,5	16	32	0,6
100	7,5	85	9,5	12,5	25	0,4
	10	80	12,5	16	32	0,6
110	7,5	95	9,5	12,5	25	0,4
	10	90	12,5	16	32	0,6
125	10	105	12,5	16	32	0,6
	12,5	100	16	20	40	0,8
140	10	120	12,5	16	32	0,6
	12,5	115	16	20	40	0,8
160	10	140	12,5	16	32	0,6
	12,5	135	16	20	40	0,8

[a] Bore diameters in accordance with ISO 3320.

[b] The application of the axial lengths specified in Tables 3 and 5 (short, medium and long) depends upon the respective working conditions.

Table 3 *(continued)*

Bore diameter[a] *D*	**Radial depth** *S*	**Inside diameter** *d*	**Axial length**[b] *L*			*r* maximum
			short	**medium**	**long**	
180	10	160	12,5	16	32	0,6
	12,5	155	16	20	40	0,8
200	12,5	175	16	20	40	
	15	170	20	25	50	
220	12,5	195	16	20	40	
	15	190	20	25	50	
250	12,5	225	16	20	40	
	15	220	20	25	50	
280		250				
320		290				
360		330				
400	20	360	25	32	63	1
450		410				
500		460				

[a] Bore diameters in accordance with ISO 3320.

[b] The application of the axial lengths specified in Tables 3 and 5 (short, medium and long) depends upon the respective working conditions.

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

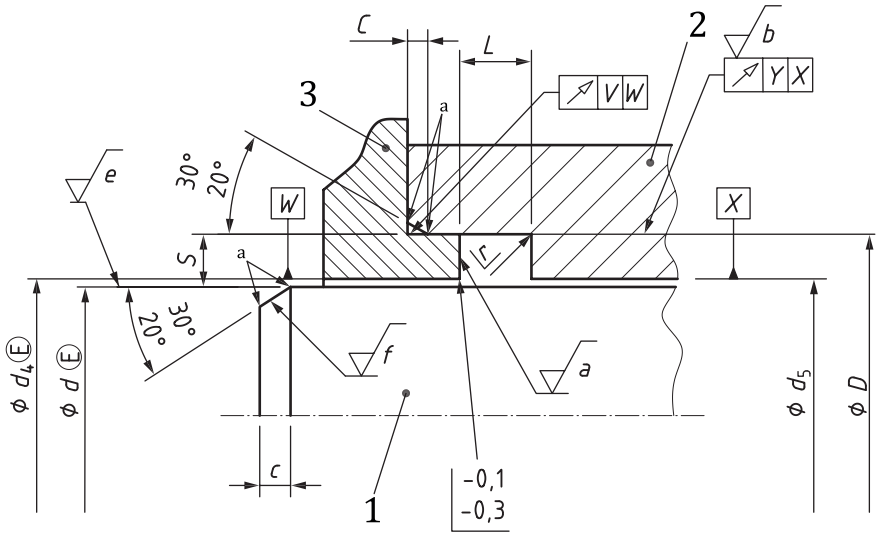
Dimensions in millimetres

Bore diameter[a] *D*	**Radial depth** *S*	**Inside diameter** *d*	**Axial length** *L*	*r*[b] maximum
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		

[a] Bore diameters in accordance with ISO 6020-2.

[b] This specific dimension permits the use of tools conforming to ISO 883.

Dimensions in millimetres



Key

1 rod
2 gland
3 seal-retaining plate
a rounded and burr-free

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

NOTE 2 Maximum run-out tolerance $V = 0{,}05$.

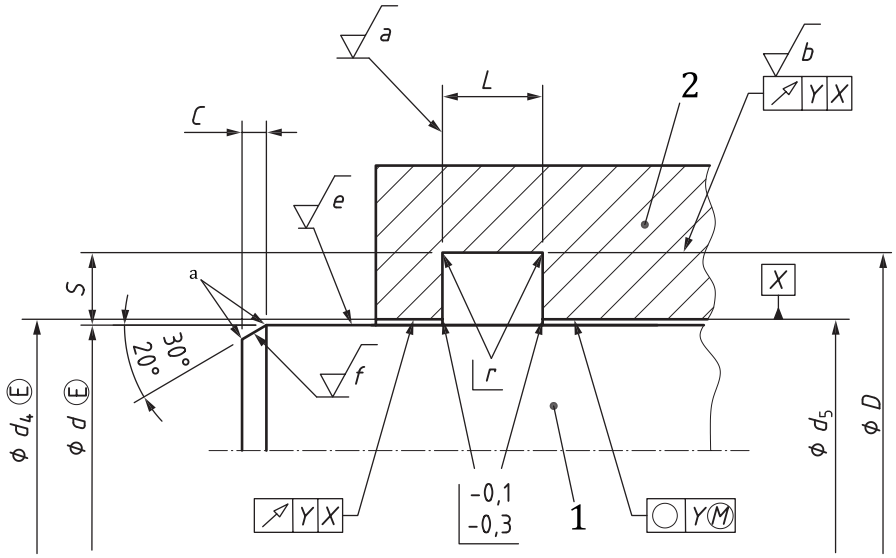
NOTE 3 See Table 1 for values of *a*, *b*, *e* and *f*.

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)

Dimensions in millimetres



Key

1 rod

2 gland

[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 6 for values of *d*, *D*, *S*, *L* and *r*.

Figure 4 — Example of rod seal housing for use with cylinders conforming to ISO 6020-2

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[a] *d*	Radial depth *S*	Outside diameter *D*	Axial length[b] *L*			*r* maximum
			short	medium	long	
6	4	14	5	6,3	14,5	0,4
8		16				
10		18				
	5	20	—	8	16	
12	4	20	5	6,3	14,5	
	5	22	—	8	16	
14	4	22	5	6,3	14,5	
	5	24	—	8	16	
16	4	24	5	6,3	14,5	
	5	26	—	8	16	
18	4	26	5	6,3	14,5	
	5	28	—	8	16	
20	4	28	5	6,3	14,5	
	5	30	—	8	16	
22	4	30	5	6,3	14,5	
	5	32	—	8	16	
25	4	33	5	6,3	14,5	
	5	35	—	8	16	
28	5	38	6,3	8	16	
	7,5	43	—	12,5	25	
32	5	42	6,3	8	16	
	7,5	47	—	12,5	25	
36	5	46	6,3	8	16	
	7,5	51	—	12,5	25	
40	5	50	6,3	8	16	
	7,5	55	—	12,5	25	
45	5	55	6,3	8	16	
	7,5	60	—	12,5	25	
50	5	60	6,3	8	16	
	7,5	65	—	12,5	25	
56		71	9,5	12,5	25	
	10	76	—	16	32	0,6
63	7,5	78	9,5	12,5	25	0,4
	10	83	—	16	32	0,6
70	7,5	85	9,5	12,5	25	0,4
	10	90	—	16	32	0,6

[a] Rod diameters in accordance with ISO 3320.

[b] The application of the axial lengths specified in Tables 3 and 5 (short, medium and long) depends upon the respective working conditions.

Table 5 *(continued)*

Rod diameter[a] *d*	**Radial depth** *S*	**Outside diameter** *D*	**Axial length**[b] *L*			*r* maximum
			short	**medium**	**long**	
80	7,5	95	9,5	12,5	25	0,4
	10	100	—	16	32	0,6
90	7,5	105	9,5	12,5	25	0,4
	10	110	—	16	32	0,6
100	10	120	12,5	16	32	0,6
	12,5	125	—	20	40	0,8
110	10	130	12,5	16	32	0,6
	12,5	135	—	20	40	0,8
125	10	145	12,5	16	32	0,6
	12,5	150	—	20	40	0,8
140	10	160	12,5	16	32	0,6
	12,5	165	—	20	40	0,8
160	12,5	185	16	20	40	
	15	190	—	25	50	
180	12,5	205	16	20	40	
	15	210	—	25	50	
200	12,5	225	16	20	40	
	15	230	—	25	50	
220		250	20			
250		280				
280		310				
320	20	360	25	32	63	1
360		400				
400		440				
450		490				

[a] Rod diameters in accordance with ISO 3320.

[b] The application of the axial lengths specified in Tables 3 and 5 (short, medium and long) depends upon the respective working conditions.

Table 6 — Nominal dimensions for rod seal housings for use with cylinders conforming to ISO 6020-2

Dimensions in millimetres

Rod diameter[a] *d*	**Radial depth** *S*	**Inside diameter** *D*	**Axial length** *L*	*r*[b] maximum
12	3,5	19	5,6	0,5
14		21		
18		25		
22		29		
28	4	36	6,3	
36		44		
45		53		
56	5	66	7,5	
70		80		
90		100		
110	7,5	125	10,6	
140		155		

[a] Rod diameters in accordance with ISO 6020-2.

[b] This specific dimension permits the use of tools conforming to ISO 883.

Table 7 — Seal housing radial depth (cross-section) — Tolerances

Dimensions in millimetres

Radial depth *S*	
Nominal	Tolerance
3,5	+0,15
	−0,05
4	+0,15
	−0,05
5	+0,15
	−0,05
7,5	+0,20
	−0,10
10	+0,25
	−0,10
12,5	+0,30
	−0,15
15	+0,35
	−0,20
20	+0,40
	−0,20

NOTE 1 For pistons:

Calculate the tolerances on the seal housing inside diameter, d (see Figures 1 and 2), in accordance with Formulae (1) and (2):

$$d_{\min} = 2D_{\max} - d_{3,\min} - 2S_{\max} \quad (1)$$

$$d_{\max} = d_{3,\min} - 2S_{\min} \quad (2)$$

NOTE 2 For rods:

Calculate the tolerances on the seal housing outside diameter, D (see Figures 3 and 4), in accordance with Formulae (3) and (4):

$$D_{\min} = d_{5,\max} + 2S_{\min} \quad (3)$$

$$D_{\max} = 2d_{,\min} - d_{5,\max} + 2S_{\max} \quad (4)$$

Bibliography

[1] ISO 286-2, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

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

[3] ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

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

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

[6] ISO 3320, *Fluid power systems and components — Cylinder bores and piston rod diameters and area ratios — Metric series*

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[9] ISO 8015, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

[10] ISO 8785, *Geometrical Product Specification (GPS) — Surface imperfections — Terms, definitions and parameters*

[11] ISO 13715, *Technical product documentation — Edges of undefined shape — Indication and dimensioning*

ICS 23.100.20

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