
**Rotary shaft lip-type seals incorporating
thermoplastic sealing elements —**

**Part 1:
Nominal dimensions and tolerances**

*Bagues d'étanchéité à lèvres pour arbres tournants incorporant des
éléments d'étanchéité thermoplastiques —*

Partie 1: Dimensions nominales et tolérances



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Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Seal types and examples	2
4.1 Seal outside diameter construction.....	2
4.2 Sealing lip arrangements	2
5 Letter symbols	3
6 Nominal dimensions.....	3
7 Shafts	4
7.1 Shaft ends	4
7.2 Diametral tolerance	5
7.3 Surface roughness and hardness.....	5
8 Housings	6
8.1 General.....	6
8.2 Dimensions	6
8.3 Housing bore tolerance.....	7
8.4 Housing bore surface roughness	7
9 Seal tolerances	7
10 Size identification code.....	8
11 Identification statement (Reference to this part of ISO 16589).....	9
Annex A (informative) Seal specification.....	10
Bibliography	13

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.

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 part of ISO 16589 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16589-1 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 7, *Sealing devices*.

ISO 16589 consists of the following parts, under the general title *Rotary shaft lip-type seals incorporating thermoplastic sealing elements*:

- *Part 1: Nominal dimensions and tolerances*
- *Part 2: Vocabulary*
- *Part 3: Storage, handling and installation*
- *Part 4: Performance test procedures*
- *Part 5: Identification of visual imperfections*

Annex A of this part of ISO 16589 is for information only.

Introduction

Rotary shaft lip-type seals are used to retain fluid in equipment where the differential pressure is relatively low. Typically, the shaft rotates and the housing is stationary, although in some applications the shaft is stationary and the housing rotates.

Dynamic sealing is normally the result of a designed interference fit between the shaft and a flexible element incorporated in the seal.

Similarly, a designed interference fit between the outside diameter of the seal and the diameter of the housing bore retains the seal and prevents static leakage.

Careful storage, handling and proper installation of all seals are necessary to avoid hazards, both prior to and during installation, which would adversely affect service life.

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Rotary shaft lip-type seals incorporating thermoplastic sealing elements —

Part 1: Nominal dimensions and tolerances

1 Scope

ISO 16589 describes seals utilizing sealing elements manufactured from suitably formulated compounds, based on thermoplastic materials, such as polytetrafluoroethylene (PTFE).

NOTE ISO 16589 is complementary to ISO 6194 which covers elastomeric seals.

This part of ISO 16589 specifies the nominal dimensions and tolerances of the seals, shafts and housings, as well as a dimensional identification code.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 16589. 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 16589 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 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 5598:1985, *Fluid power systems and components — Vocabulary*

ISO 16589-2:2001, *Rotary shaft lip-type seals incorporating thermoplastic sealing elements — Part 2: Vocabulary*

3 Terms and definitions

For the purposes of this part of ISO 16589, the terms and definitions given in ISO 5598 and ISO 16589-2 apply.

4 Seal types and examples

4.1 Seal outside diameter construction

The constructions shown in Figure 1 show three basic types.

NOTE Because of some variations in design details, or seals made by different manufacturers, the constructions shown are intended only as representative of the basic types.

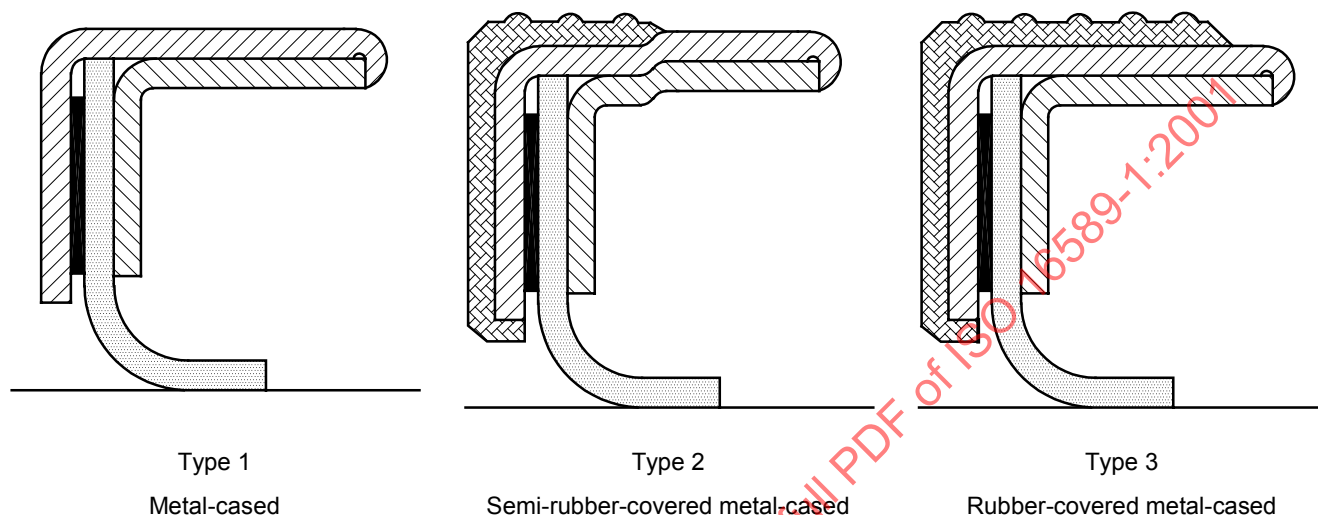


Figure 1 — Three basic types of outside diameter construction

4.2 Sealing lip arrangements

Some examples of sealing lip arrangements are shown in Figure 2.

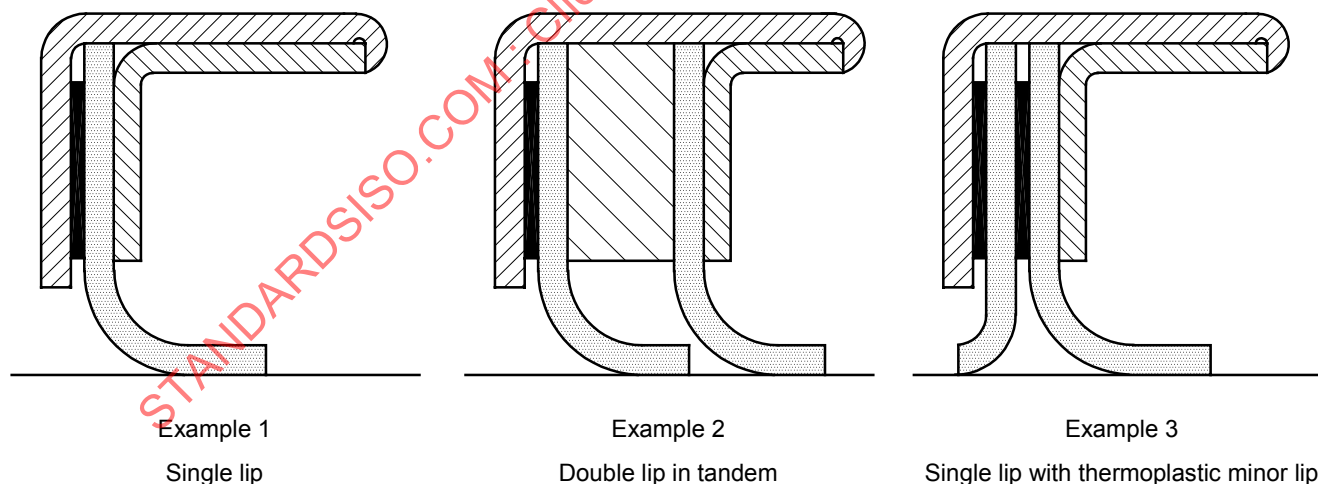


Figure 2 — Sealing lip arrangements

The sealing lip arrangements shown in Figure 2 can be used with each seal outside diameter construction shown in Figure 1.

Hydrodynamic aids are incorporated by some manufacturers in certain applications.

The design of the sealing lip should be agreed on between manufacturer and purchaser.

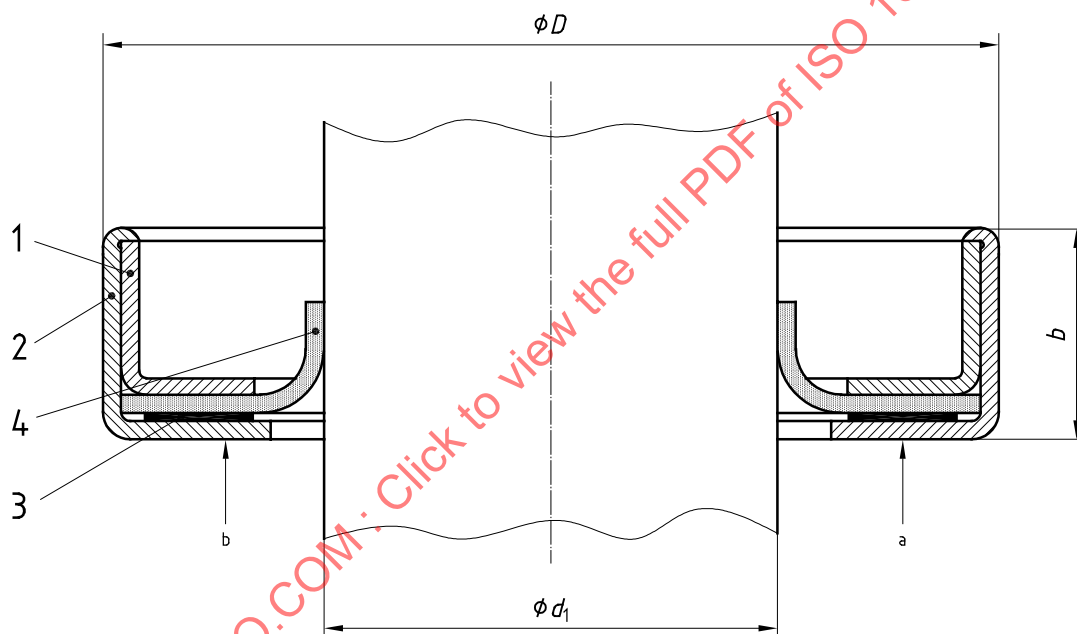
5 Letter symbols

Letter symbols used in this part of ISO 16589 are as follows:

- b is the nominal width of the seal and is associated with the housing bore depth (see Figure 3);
- d_1 is the nominal diameter of the shaft to be used with the seal (see Figure 4);
- d_2 is the minor diameter at the shaft lead-in chamfer (see Figure 4);
- D is the nominal diameter of the housing bore and of the outer diameter of the seal (see Figures 3 and 5).

6 Nominal dimensions

The nominal dimensions of the seals are shown in Figure 3 and given in Table 1:



Key

- 1 Inner case
- 2 Outer case
- 3 Gasket (if incorporated)
- 4 Sealing element
- a Rotation viewed from back face
- b Identification (preferred location) on back side

Figure 3 — Seal

Table 1 — Nominal dimensions

Dimensions in millimetres

d_1	D	b^a	d_1	D	b^a	d_1	D	b^a	d_1	D	b^a
6	16	7	25	52	7	45	65	8	120	150	12
6	22	7	28	40	7	50	65	8	130	160	12
7	22	7	28	47	7	50	72	8	140	170	15
8	22	7	28	52	7	55	72	8	150	180	15
8	24	7	30	42	7	55	80	8	160	190	15
9	22	7	30	47	7	60	80	8	170	200	15
10	22	7	30	52	7	60	85	8	180	210	15
10	25	7	32	45	8	65	85	10	190	220	15
12	24	7	32	47	8	65	90	10	200	230	15
12	25	7	32	52	8	70	90	10	220	250	15
12	30	7	35	50	8	70	95	10	240	270	20
15	26	7	35	52	8	75	95	10	260	300	20
15	30	7	35	55	8	75	100	10	280	320	20
15	35	7	38	55	8	80	100	10	300	340	20
16	30	7	38	58	8	80	110	10	320	360	20
18	30	7	38	62	8	85	110	12	340	380	20
18	35	7	40	55	8	85	120	12	360	400	20
20	35	7	40	62	8	90	120	12	380	420	20
20	40	7	42	55	8	95	120	12	400	440	20
22	35	7	42	62	8	100	125	12	450	500	25
22	40	7	45	62	8	110	140	12	480	530	25
22	47	7									
25	40	7									
25	47	7									

^a The width b may be increased to permit the use of more complex seal configurations.

7 Shafts

7.1 Shaft ends

The end of the shaft shall be provided with a lead-in chamfer as shown in Figure 4 and given in Table 2, and shall be free from burrs, sharp corners or rough machining marks.

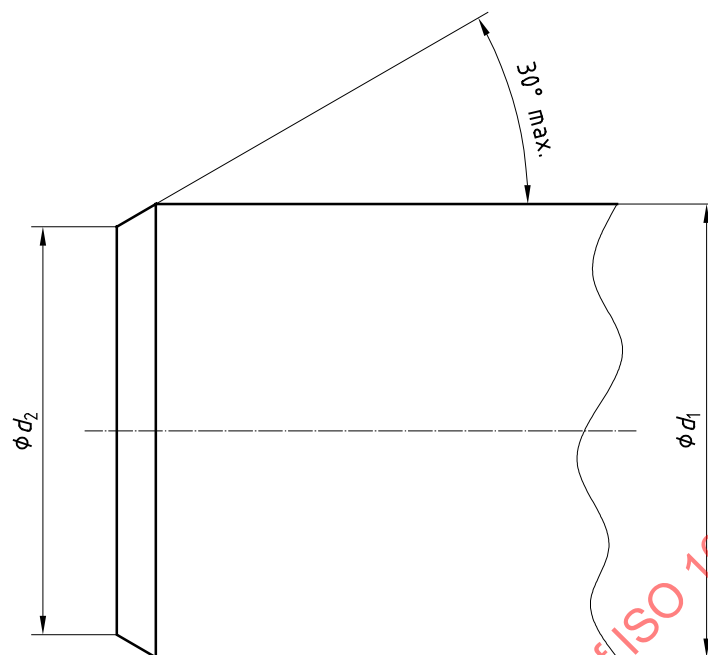


Figure 4 — Shaft lead-in chamfer

Table 2 — Shaft lead-in chamfer

Dimensions in millimetres

Shaft diameter d_1	$d_1 - d_2^a$ min.	Shaft diameter d_1	$d_1 - d_2^a$ min.
$d_1 \leq 10$	1,5	$50 < d_1 \leq 70$	4
$10 < d_1 \leq 20$	2	$70 < d_1 \leq 95$	4,5
$20 < d_1 \leq 30$	2,5	$95 < d_1 \leq 130$	5,5
$30 < d_1 \leq 40$	3	$130 < d_1 \leq 240$	7
$40 < d_1 \leq 50$	3,5	$240 < d_1 \leq 480$	11
^a If a shaft lead-in chamfer radius is used, it shall be no less than this diametral difference.			

NOTE Assembly tools are specified in ISO 16589-3 and should be used to ensure that the sealing lip/elements are not damaged.

7.2 Diametral tolerance

The shaft shall have a diametral tolerance not greater than h11 (see ISO 286-2).

7.3 Surface roughness and hardness

7.3.1 Surface roughness

The seal contact surface of a ground shaft shall be finished to a surface roughness of between Ra 0,2 μm and Ra 0,63 μm , or between Rz 0,8 μm and Rz 2,5 μm , measured in the axial direction in accordance with ISO 4287 and ISO 4288.

NOTE Shafts which have a very hard coating may require a smoother surface finish; the user should consult the seal manufacturer.

The seal contact surface shall normally be free of machining leads.

7.3.2 Surface hardness

The surface hardness shall be agreed on between purchaser and manufacturer.

8 Housings

8.1 General

The housing contains the bore into which the seal shall be fitted.

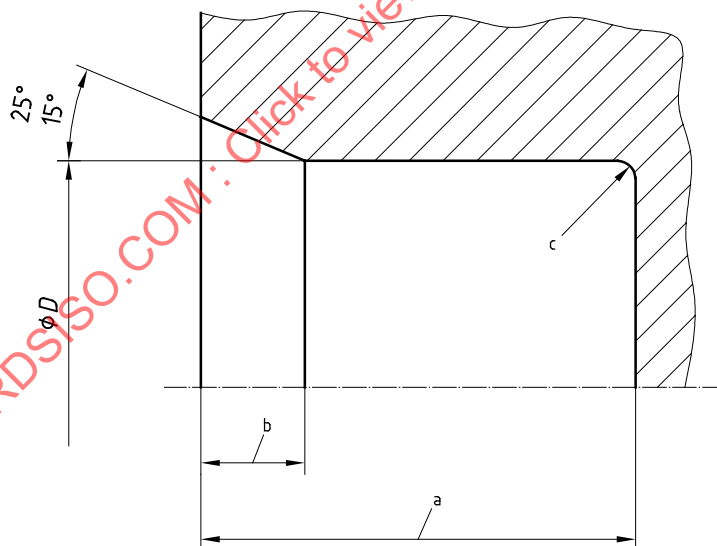
8.2 Dimensions

8.2.1 Where this housing is a rigid, fully machined ferrous part, the housing bore shall be in accordance with 8.3 and 8.4.

8.2.2 The housing bore shall be provided with a lead-in chamfer, free from burrs, as shown in Figure 5 and specified in Table 3.

8.2.3 The housing bore depth and corner radius shall be as shown in Figure 5 and specified in Table 3.

NOTE If the housing is not in accordance with 8.2.1 to 8.2.3 (e.g. non-ferrous or non-metallic material, pressing of ferrous or non-ferrous material), the dimensions, tolerances and lead-in configuration should be agreed between the purchaser and manufacturer.



- a Bore depth
- b Chamfer length
- c Corner radius

Figure 5 — Housing bore

Table 3 — Housing bore dimensions

Dimensions in millimetres

Nominal width b	Minimum housing bore depth	Chamfer length	Maximum housing bore corner radius
$b \leq 10$	$b + 1,2$	0,7 to 1	0,5
$b > 10$	$b + 1,5$	1 to 1,3	0,75

8.3 Housing bore tolerance

The housing bore shall have a diametral tolerance not greater than H8 (see ISO 286-2).

8.4 Housing bore surface roughness

The surface roughness of the housing bore shall be within Ra 1,6 μm and Ra 3,2 μm , or between Rz 6,3 μm and Rz 12,5 μm , measured in the axial direction in accordance with ISO 4287 and ISO 4288.

9 Seal tolerances

9.1 The recommended seal width tolerances are given in Table 4.

Table 4 — Seal width tolerances

Dimensions in millimetres

Seal width b	Tolerance
$b \leq 10$	$\pm 0,3$
$10 < b \leq 14$	$\pm 0,4$
$14 < b \leq 18$	$\pm 0,5$
$18 < b \leq 25$	$\pm 0,6$

9.2 To provide an interference fit between the seal outside surface and the housing bore surface, the recommended tolerances for the outside diameter of the seal shall be as given in Table 5.

NOTE Since the interference between the seal outside surface and the housing bore surface is a characteristic related to the design of the seal, it may be necessary for agreement to be reached between purchaser and manufacturer on the limits to be used. See annex A for the recommended form.

Table 5 — Seal outside diameter tolerances

Dimensions in millimetres

Nominal outside diameter D	Diametral tolerance		Roundness tolerance ^a	
	Metal-cased	Rubber-covered ^{b, c}	Metal-cased	Rubber-covered
$D \leq 50$	+ 0,20 + 0,08	+ 0,30 + 0,15	0,18	0,25
$50 < D \leq 80$	+ 0,23 + 0,09	+ 0,35 + 0,20	0,25	0,35
$80 < D \leq 120$	+ 0,25 + 0,10	+ 0,35 + 0,20	0,3	0,5
$120 < D \leq 180$	+ 0,28 + 0,12	+ 0,45 + 0,25	0,4	0,65
$180 < D \leq 300$	+ 0,35 + 0,15	+ 0,45 + 0,25	0,25 % of outside diameter	0,8
$300 < D \leq 530$	+ 0,45 + 0,20	+ 0,55 + 0,30	0,25 % of outside diameter	1

^a The roundness tolerance is equal to the difference between the maximum diameter and the minimum diameter derived from three or more equally spaced measurements.

^b Rubber-covered and semi-rubber-covered seals having a wave profile outside surface are acceptable but will require different tolerances to be agreed on between manufacturer and purchaser.

^c Rubber-covered and semi-rubber-covered seals employing certain materials other than nitrile may require different tolerances to be agreed on between manufacturer and purchaser.

10 Size identification code

10.1 The size identification code shall consist of the nominal dimensions of the shaft and housing, as given in Table 1.

10.2 Examples of size identification code are given in Table 6.

Table 6 — Size identification code

Dimensions in millimetres

d_1	D	Size code
6	16	006016
70	90	070090
400	440	400440

11 Identification statement (Reference to this part of ISO 16589)

Manufacturers are strongly recommended to use the following statement in test reports, catalogues and sales literature when electing to comply with this part of ISO 16589:

“The nominal dimensions and tolerances of the seals, shafts and housings are in accordance with ISO 16589-1:2001, *Rotary shaft lip-type seals incorporating thermoplastic sealing elements — Part 1: Nominal dimensions and tolerances.*”

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Annex A (informative)

Seal specification

A.1 For the convenience of both the purchaser and the manufacturer, it is recommended that the purchaser complete a form such as the one given in Table A.1, to supply the necessary information to the manufacturer to ensure the supply of a seal suitable for the application.

A.2 It is also recommended that the manufacturer complete a form such as the one given in Table A.2 to supply the purchaser with the necessary information to ensure that the seal is in accordance with the equipment design and application requirements, to enable the purchaser to carry out inspection or quality control on the seals supplied by the manufacturer.

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