Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

Indian Standard

ROTARY SHAFT LIP-TYPE SEALS INCORPORATING ELASTOMERIC SEALING ELEMENTS

PART 1 NOMINAL DIMENSIONS AND TOLERANCES

ICS 23.100.60; 83.140.50
NATIONAL FOREWORD

This Indian Standard (Part 1) which is identical with ISO 6194-1 : 2007 'Rotary shaft lip-type seals incorporating elastomeric sealing elements — Part 1: Nominal dimensions and tolerances' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Gaskets and Packing Sectional Committee and approval of the Mechanical Engineering Division Council.

This standard supersedes IS 5129 (Part 1) : 2000 'Rotary shaft lip-type seals : Part 1 Nominal dimensions and tolerances'.

ISO 6194 consists of five parts, under the general title rotary shaft lip-type seals incorporating elastomeric sealing elements. Other parts are as follows:

- Part 2 Vocabulary
- Part 3 Storage, handling and installation
- Part 4 Performance test procedures
- Part 5 Identification of visual imperfections

The text of the ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their places are listed below along with their degree of equivalence for the editions indicated:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 5598 : 1985 Fluid power systems and components — Vocabulary</td>
<td>IS 10416 : 1992 Fluid power systems and components — Vocabulary (first revision)</td>
<td>do</td>
</tr>
</tbody>
</table>

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
1 Scope

This part of ISO 6194 describes seals utilising elastomeric sealing elements. They are considered suitable for use under low-pressure conditions (see 6.1).

This part of ISO 6194 shows seal types and examples. It also specifies the nominal dimensions and tolerances of the seals, shafts and housings, as well as a dimensional identification code.

NOTE ISO 6194 is complementary to ISO 16589 which covers seals incorporating thermoplastic sealing elements.

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

ISO 5598, Fluid power systems and components — Vocabulary

ISO 6194-2, Rotary shaft lip-type seals — Part 2: Vocabulary

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and ISO 6194-2 apply.

4 Symbols

The symbols used in this part of ISO 6194 are as follows:

- housing-bore depth;
- nominal inside diameter of the inner case;
- nominal seal width;
- housing chamfer length;
$D_1$ nominal diameter of the shaft to be used with the seal;

$d_m$ minor diameter at the shaft lead-in chamfer;

$D_2$ nominal diameter of the housing bore and outer diameter of the seal;

$r$ housing corner radius.

5 Seal types and examples

5.1 Seal outside-diameter construction

The constructions shown in Figure 1 show four basic types.

![Types of Seal Outside-Diameter Construction](image)

**Type 1** Metel-cased

**Type 2** Metal-cased with inner case

**Type 3** Semi-rubber-covered metal-cased

**Type 4** Rubber-covered metal-cased

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

Figure 1 — Four basic types of outside-diameter construction

5.2 Sealing lip arrangements

Examples of sealing lip arrangements are shown in Figure 2.

![Sealing Lip Arrangements](image)

a) Single lip

b) Single lip with protection lip

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 on the main lip may be incorporated by some manufacturers in certain applications.

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

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

6 Pressure and nominal dimensions

6.1 Pressure

Seals of this type are normally used with atmospheric pressure on the air side, and sealing fluids at pressures from 0 kPa to 30 kPa (0,3 bar) above atmospheric pressure. The user should consult the seal manufacturer regarding use at other pressures.

6.2 Nominal dimensions

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

Figure 3 — Seal
Table 1 — Nominal dimensions

<table>
<thead>
<tr>
<th>$D_1$</th>
<th>$D_2$</th>
<th>$b^a$</th>
<th>$D_1$</th>
<th>$D_2$</th>
<th>$b^a$</th>
<th>$D_1$</th>
<th>$D_2$</th>
<th>$b^a$</th>
<th>$D_1$</th>
<th>$D_2$</th>
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</tr>
</tbody>
</table>

*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 edges or rough machining marks.
Key

- \(d_n\): minor diameter at the shaft lead-in chamfer
- \(D_1\): nominal diameter of the shaft to be used with the seal

Figure 4 — Shaft lead-in chamfer

Table 2 — Shaft lead-in chamfer

<table>
<thead>
<tr>
<th>Shaft diameter (D_1)</th>
<th>(d_{m_{\text{max.}}})</th>
<th>Shaft diameter (D_1)</th>
<th>(d_{m_{\text{max.}}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D_1 \leq 10)</td>
<td>(D_1 - 1.5)</td>
<td>(50 &lt; D_1 \leq 70)</td>
<td>(D_1 - 4.0)</td>
</tr>
<tr>
<td>10 &lt; (D_1 \leq 20)</td>
<td>(D_1 - 2.0)</td>
<td>(70 &lt; D_1 \leq 95)</td>
<td>(D_1 - 4.5)</td>
</tr>
<tr>
<td>20 &lt; (D_1 \leq 30)</td>
<td>(D_1 - 2.5)</td>
<td>(95 &lt; D_1 \leq 130)</td>
<td>(D_1 - 5.5)</td>
</tr>
<tr>
<td>30 &lt; (D_1 \leq 40)</td>
<td>(D_1 - 3.0)</td>
<td>(130 &lt; D_1 \leq 240)</td>
<td>(D_1 - 7.0)</td>
</tr>
<tr>
<td>40 &lt; (D_1 \leq 50)</td>
<td>(D_1 - 3.5)</td>
<td>(240 &lt; D_1 \leq 480)</td>
<td>(D_1 - 11.0)</td>
</tr>
</tbody>
</table>

Assembly tools are specified in ISO 6194-3 and should be used to ensure that the sealing lip is not damaged.

If a radius is used instead of a lead-in chamfer, its value shall be between 1.8 mm and 3.0 mm.

**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, measured in the axial direction of between $Ra\ 0,2\ \mu m$ and $Ra\ 0,5\ \mu m$, and between $Rz\ 1,2\ \mu m$ and $Rz\ 3,0\ \mu m$.

Some surface finish processes will not provide roughness values that fall within the limits given in this part of ISO 6194. Surface roughness requirements shall be determined between the manufacturer of the surface and the seal supplier.

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

Ground and polished shafts may require other grades of surface texture, in which case they should be subject to agreement between the manufacturer and user.

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

7.3.2 Surface hardness

Unless otherwise agreed on between the manufacturer and user, the surface hardness of the shaft should be a minimum of 30 Rockwell C. If the shaft could be subject to damage during handling, this should be increased to 45 Rockwell C.

8 Housings

8.1 Dimensions

8.1.1 Where the housing is a rigid fully machined ferrous part, the housing bore shall conform to 8.2 and 8.3.

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

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

If the housing is not in accordance with 8.1.1 to 8.1.3 (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.
8.2 Housing-bore tolerance

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

8.3 Housing-bore surface roughness

The surface roughness of the housing bore, measured in the axial direction, shall be between $Ra$ 1,6 μm and $Ra$ 3,2 μm, and between $Rz$ 6,3 μm and $Rz$ 12,5 μm.

No visible surface imperfections are allowed.

The housing-bore surface roughness may require lower values when metal cased seals are used, in which case they should be subject to agreement between the manufacturer and user.

9 Seal tolerances

9.1 Seal width

The recommended seal width tolerances are listed below in Table 4.
Table 4 — Seal width tolerance

<table>
<thead>
<tr>
<th>Nominal seal width $b$</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b \leq 10$</td>
<td>$\pm 0.3$</td>
</tr>
<tr>
<td>$10 &lt; b \leq 14$</td>
<td>$\pm 0.4$</td>
</tr>
<tr>
<td>$14 &lt; b \leq 18$</td>
<td>$\pm 0.5$</td>
</tr>
<tr>
<td>$18 &lt; b \leq 25$</td>
<td>$\pm 0.6$</td>
</tr>
</tbody>
</table>

9.2 Seal outside diameter

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 shown in Table 5.

The seal outside diameter tolerances in Table 5 are to be used for ferrous housings only. If non-ferrous housing materials are used, the seal manufacturer shall be consulted. The seal manufacturer provides the proper recommendations regarding the interference fit between the seal and the non-ferrous housing.

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 the purchaser and manufacturer on the limits to be used. See Annex A for the recommended form.

Table 5 — Seal outside-diameter tolerances

<table>
<thead>
<tr>
<th>Nominal outside diameter</th>
<th>Diametral tolerance</th>
<th>Roundness tolerance $a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_2$</td>
<td>Metal cased</td>
<td>Rubber covered $b, c$</td>
</tr>
<tr>
<td>$D_2 \leq 50$</td>
<td>$+0.20$</td>
<td>$+0.30$</td>
</tr>
<tr>
<td></td>
<td>$+0.08$</td>
<td>$+0.15$</td>
</tr>
<tr>
<td>$50 &lt; D_2 \leq 80$</td>
<td>$+0.23$</td>
<td>$+0.35$</td>
</tr>
<tr>
<td></td>
<td>$+0.09$</td>
<td>$+0.20$</td>
</tr>
<tr>
<td>$80 &lt; D_2 \leq 120$</td>
<td>$+0.25$</td>
<td>$+0.35$</td>
</tr>
<tr>
<td></td>
<td>$+0.10$</td>
<td>$+0.20$</td>
</tr>
<tr>
<td>$120 &lt; D_2 \leq 180$</td>
<td>$+0.28$</td>
<td>$+0.45$</td>
</tr>
<tr>
<td></td>
<td>$+0.12$</td>
<td>$+0.25$</td>
</tr>
<tr>
<td>$180 &lt; D_2 \leq 300$</td>
<td>$+0.35$</td>
<td>$+0.45$</td>
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<td>$+0.15$</td>
<td>$+0.25$</td>
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<tr>
<td>$300 &lt; D_2 \leq 530$</td>
<td>$+0.45$</td>
<td>$+0.55$</td>
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<tr>
<td></td>
<td>$+0.20$</td>
<td>$+0.30$</td>
</tr>
</tbody>
</table>
The roundness tolerance is equal to the difference between the maximum diameter and the minimum diameter derived from three or more equally spaced measurements.

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

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

## 10 Size identification code

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

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

### Table 6 — Examples of size identification code

<table>
<thead>
<tr>
<th>$D_1$</th>
<th>$D_2$</th>
<th>Size code</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>16</td>
<td>006016</td>
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<tr>
<td>70</td>
<td>90</td>
<td>070090</td>
</tr>
<tr>
<td>400</td>
<td>440</td>
<td>400440</td>
</tr>
</tbody>
</table>

## 11 Identification statement (Reference to this part of ISO 6194)

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 6194:

"The nominal dimensions and tolerances of the seals, shafts and housings conform to ISO 6194-1, *Rotary shaft lip-type seals incorporating elastomeric sealing elements — Part 1: Nominal dimensions and tolerances.*"
Annex A
(informative)

Seal specification

A.1 For the convenience of both the purchaser and 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.
<table>
<thead>
<tr>
<th>Table A.1 — Purchaser’s information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purchaser:</strong></td>
</tr>
<tr>
<td><strong>Application:</strong></td>
</tr>
</tbody>
</table>

### 1 Shaft information
- **a)** Diameter \((D_1)\) \(\text{mm max} \ldots \text{mm min}\)
- **b)** Material \(\ldots\)
- **c)** Surface roughness \(Ra\) \(\mu m\) \(Rz\) \(\ldots \mu m\)
- **d)** Type of finish \(\ldots\)
- **e)** Hardness \(\ldots\)
- **f)** Chamfer information \(\ldots\)
- **g)** Rotation
  1. Direction of rotation
     - Clockwise \(\ldots\)
     - Anti-clockwise \(\ldots\)
     - Bi-rotational \(\ldots\)
  2. Rotation speed \(\ldots \text{min}^{-1}\)
  3. Rotation cycles (Time on \ldots \ Time off \ldots )
- **h)** Other shaft motion (if applicable)
  1. Axial reciprocation
     - Length of stroke \(\text{mm}\)
     - Cycles per minute \(\ldots\)
     - Reciprocation cycles (Time on \ldots \ Time off \ldots )
  2. Circumferential oscillation
     - Magnitude of oscillation \(\text{Degrees}\)
     - Cycles per minute \(\ldots\)
     - Oscillation cycles (Time on \ldots \ Time off \ldots )
- **i)** Additional information (i.e. splines, holes, keyways, shaft lead, etc.)

### 2 Housing information
- **a)** Bore diameter \((D_2)\) \(\text{mm max} \ldots \text{mm min}\)
- **b)** Bore depth \((a)\) \(\text{mm max} \ldots \text{mm min}\)
- **c)** Material \(\ldots\)
- **d)** Surface roughness \(Ra\) \(\mu m\) \(Rz\) \(\ldots \mu m\)
- **e)** Chamfer information \(\ldots\)
- **f)** Housing rotation (if applicable)
  1. Direction of rotation
     - Clockwise \(\ldots\)
     - Anti-clockwise \(\ldots\)
     - Bi-rotational \(\ldots\)
  2. Rotation speed \(\ldots \text{min}^{-1}\)

### 3 Contained fluid information
- **a)** Type of fluid \(\ldots\) Grades \(\ldots\)
- **b)** Fluid temperature \(\text{Normal} \ldots \text{°C Max} \ldots \text{°C Min} \ldots \text{°C}\)
- **c)** Temperature cycles \(\ldots\)
- **d)** Fluid level \(\ldots\)
- **e)** Fluid pressure \(\ldots \text{kPa bar}\)
- **f)** Pressure cycle \(\ldots\)

### 4 Alignment
- **a)** Housing-bore eccentricity \(\ldots \text{mm}\)
- **b)** Shaft runout (FIM) \(\ldots \text{mm}\)

### 5 External conditions
- **a)** External pressure \(\ldots \text{kPa bar}\)
- **b)** Materials to be excluded (i.e. dust, mud, water, etc.) \(\ldots\)

**a)** Direction of rotation viewed from the air side.
Table A.2 — Manufacturer's information

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Seal specification:
- **Type:** .................................................. Nominal shaft diameter ($D_1$): ..................................
- **Outside diameter ($D_2$):** .................................. mm max ........................................................ mm min.
- **Seal width ($b$):** ........................................ mm max ........................................................ mm min.
- **Inner case diameter ($a$):** ................................ mm max ........................................................ mm min.

Sealing lip description (delete where not applicable):
- **Plain lip**
- **Lip incorporating hydrodynamic aids**
- **Uni-directional RH/LH**
- **Bi-directional**

Sealing lip material .................................................. Case specifications:
- **Outer case material** ........................................ Inner case material ........................................
- **Outer case thickness** ....................................... Inner case thickness ........................................

Spring material .......................................................... Optional information ........................................

Test specification ..........................................................

Example drawing:

![Example drawing](image)

**Key**
1. preferred identification location

$D_1$ nominal diameter of the shaft to be used with the seal

$D_2$ nominal diameter of the housing bore and outer diameter of the seal

$d$ nominal diameter of the inner case

$b$ nominal seal width

$a$ Direction of rotation indicator viewed from air side.
Bibliography

[1] ISO 48:1994, Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)


[8] ISO 7986, Hydraulic fluid power — Sealing devices — Standard test methods to assess the performance of seals used in oil hydraulic reciprocating applications


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