INTERNATIONAL STANDARD

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Rotary shaft lip-type seals incorporating elastomeric sealing elements —

Part 4: Performance test procedures

Bagues d'étanchéité à lèvres pour arbres tournants incorporant des éléments d'étanchéité en élastomère —
Partie 4: Méthodes d'essai de performance

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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 6194-4 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 6194-4:1999), which has been technically revised.

ISO 6194 consists of the following parts, under the general title *Rotary shaft lip-type seals incorporating elastomeric 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*

Introduction

Rotary shaft lip-type seals are used to retain fluid, e.g. lubricant, 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.

Rotary shaft lip-type seals incorporating elastomeric sealing elements —

Part 4:
Performance test procedures

WARNING — Persons using this part of ISO 6194 should be familiar with normal laboratory practice. Whilst this part of ISO 6194 does not purport to address all the safety problems, if any, associated with its application, attention is drawn to the need to employ sensible precautions while handling hot and cold fluids and equipment. It is the responsibility of the user of this part of ISO 6194 to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

ISO 6194 describes seals utilizing elastomeric sealing elements. They are considered suitable for use under low-pressure conditions (see ISO 6194-1:2007, 6.1).

This part of ISO 6194 specifies general test requirements for rotary shaft lip-type seals. The tests may be used for qualification purposes.

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 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 812, *Rubber, vulcanized or thermoplastic — Determination of low-temperature brittleness*

ISO 815-1, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*

ISO 815-2, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 2: At low temperatures*

ISO 1817, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 2781, *Rubber, vulcanized or thermoplastic — Determination of density*

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

ISO 6194-1:2007, *Rotary shaft lip-type seals incorporating elastomeric sealing elements — Part 1: Nominal dimensions and tolerances*

ISO 6194-2, *Rotary-shaft lip-type seals incorporating elastomeric sealing elements — Part 2: Vocabulary*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
batch
identifiable and traceable consignment of rubber compound of definite composition and manufactured in a single production operation

3.2 Symbols

For the purposes of this document, the symbols given in ISO 6194-1 apply.

4 Pre-test procedure

4.1 Inspect all seals submitted for testing for conformity to a relevant drawing or detailed specification declared by the seal manufacturer.

4.2 For seals with an elastomeric component, ensure that the seal manufacturer has stated the material designation batch number from which the seals have been made, together with the nominal density, nominal hardness, maximum compression set value and maximum volume change after immersion in the test fluid.

Where the seal is required for the low-temperature stiffness test, ensure that the seal manufacturer has also stated the maximum modulus after test at the selected test temperature.

Ensure that the batch of elastomer has been tested in accordance with Clause 7.

4.3 To facilitate accurate analysis of the test results, determine the following data concerning the physical characteristics of the seal and test apparatus before testing:

a) lip diameter (with spring);

b) lip diameter (without spring, measured not less than 24 h after removal of spring);

c) outer case mean diameter and out-of-roundness;

d) shaft diameter, material hardness and surface roughness;

e) housing diameter, material and surface roughness;

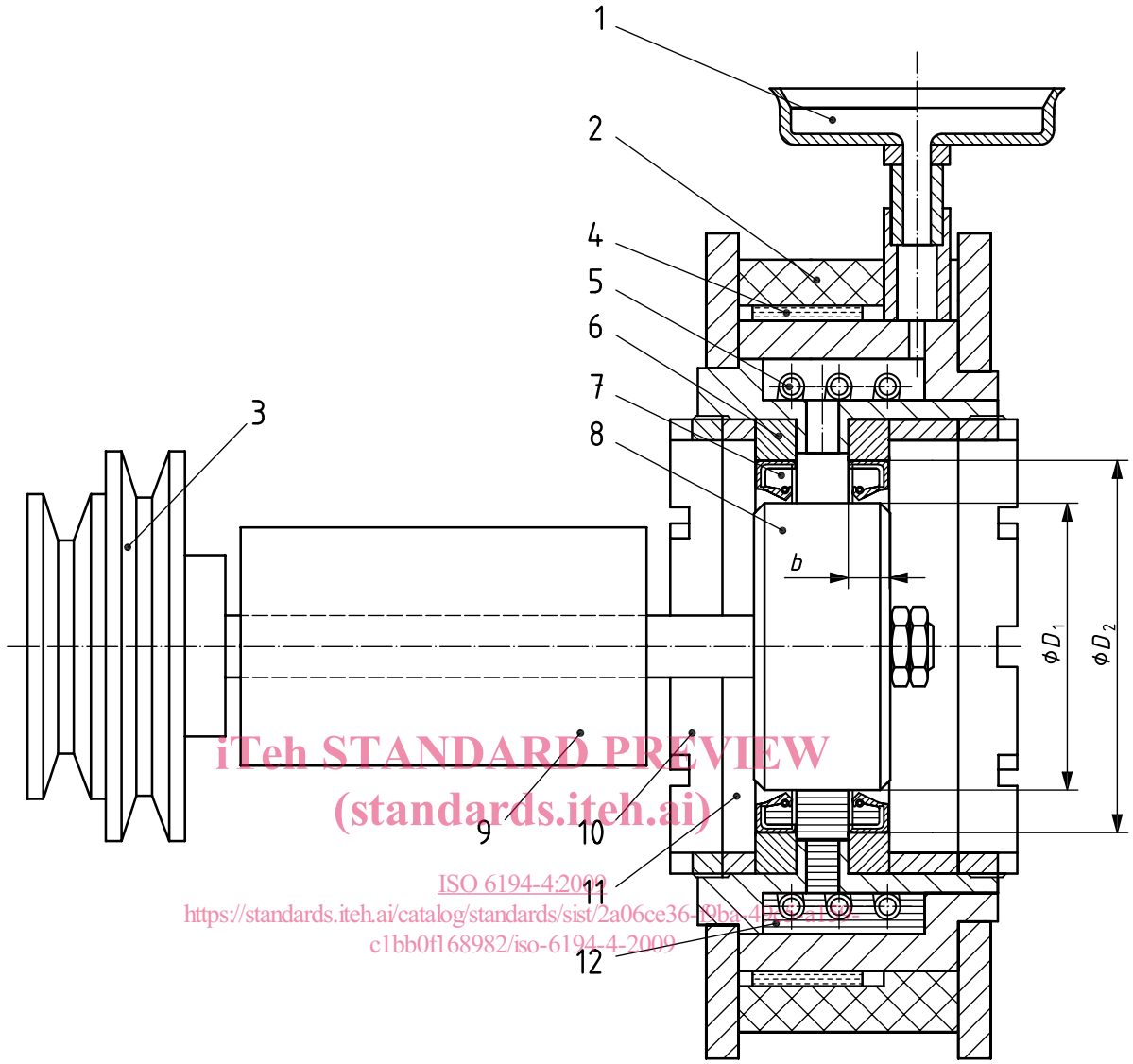
f) protection lip diameter, where applicable (with and without sealing lip spring fitted).

4.4 Ensure that the specified shaft eccentricity and housing off-set of the test apparatus have been incorporated.

5 Dynamic normal-temperature test

5.1 Test apparatus

The test apparatus shall be similar to the typical example shown in Figure 1 and shall consist of a suitable housing for retaining the test fluid and for positioning the test seals, as well as a rotating member having a spindle mounted horizontally on suitable bearings. The design of the housing for the seal shall be in accordance with the dimensions specified in ISO 6194-1. The housing and the rotating member shall be capable of reproducing the eccentricity and off-set specified in 4.4.



Key

1 filler tray
2 insulation
3 drive from prime mover
4 heater band
5 cooling coil
6 seal housing
7 test seal
8 test shaft
9 test head support
10 locking ring
11 spacer ring
12 test fluid

b nominal seal width
D_1 nominal diameter of the shaft to be used with the seal
D_2 nominal diameter of the housing bore or outer diameter of the seal

Figure 1 — Typical example of dynamic normal-temperature test apparatus

Where it is not practicable to provide a test apparatus with the particular shaft and housing size relevant to the application, the test apparatus shall be selected from the standard sizes listed in Table 1. The size selected shall be that nearest to the application size.

Table 1 — Standard shaft and housing dimensions

Dimensions in millimetres

Shaft diameter D_1	Housing diameter D_2	Seal width b
20	35	7
40	55	8
60	80	8
90	120	12
200	230	15

The test apparatus shall also conform to the following additional requirements.

a) The shaft shall be capable of cycling and/or maintaining the shaft speeds to within ± 3 %.

b) The shaft shall be capable of maintaining the specified test eccentricity under dynamic conditions to within ± 0,03 mm throughout each test.

c) The test head shall be designed and constructed so as to maintain the housing bore alignment relative to the test shaft axis within 0,03 mm throughout the operating temperature range.

d) The design of the test head support shall ensure minimum deformation and vibration.

e) The test head and heat transfer system shall be capable of maintaining the temperature of the test fluid within ± 3 °C, and shall be vented to atmosphere.

f) Heat shall be applied in a manner that does not subject the test fluid to high localized temperatures that could cause fluid decomposition.

g) The test shaft shall have a surface that is free of helical machine marks and shall comply with the requirements for shafts specified in ISO 6194-1.

h) The test housing bore shall comply with the requirements specified in ISO 6194-1.

i) The materials, surface finish and dimensions of the test shaft and test housing bore shall conform as closely as possible to the shaft and housing bore to be used in service.

j) A minimum quantity of 750 cm^3 of test fluid shall be used.

k) The level of the test fluid in the test head shall be $0{,}3D_1$ to $0{,}5D_1$ above the lowest point of the shaft diameter D_1.

l) For seal housings with inboard bearings, the test housing shall be suitably relieved at the bearing supports to prevent excessive fluid pressure between the bearing and seals.

m) Means shall be provided for collecting and measuring the mass of any fluid leakage from the seals during the test.

n) The test head shall have a device capable of pressurizing the seal housing to the working pressure.

o) A liquid level measuring device shall be provided on the test head.

5.2 Installation

5.2.1 Thoroughly clean the test head of contaminants and extraneous matter.

5.2.2 Install the seal into the test head so that the cumulative eccentricities of the seal and the test head are known.

5.2.3 Ensure that the plane of the seal lip is perpendicular to the shaft axis, unless otherwise specified.

5.2.4 Locate the test shaft in such a position that a clean unused area of its surface is in contact with the sealing element of the test seal.

5.3 Test conditions

Apply test conditions that simulate the seal application operating conditions, as agreed between purchaser and supplier, i.e. normal operating temperature, normal operating shaft speed, maximum envisaged operating temperature and maximum envisaged shaft speed.

5.4 Test procedure

Submit six seals to 10 cycles, each of 24 h duration, consisting of 14 h at normal operating temperature and speed, according to service conditions, and 6 h at the maximum envisaged operating temperature and speed, followed by a 4 h shutdown when the test machine is allowed to return to room temperature. For lifetime performance testing, duration will be extended in agreement between purchaser and supplier.

5.5 Post-test measurements

After completion of the test, determine the seal lip diameters, the minor lip diameters where applicable, and the contact bandwidth. Inspect the seal lip, noting any cracks, tears, splits or any imperfections that may have appeared as a result of the test.

5.6 Recording

Record all test data on a seal test report. An example of a seal test report for a dynamic test is shown in Annex A.

5.7 Acceptance criteria

Unless otherwise agreed between manufacturer and purchaser, there shall be no visible leakage (i.e. any wetness on the outside of the seal) from all six seals.

NOTE Seal performance can be influenced by operating and environmental conditions beyond the scope of this test. Therefore, the fact that seals pass, is no guarantee of zero leakage in service.

6 Dynamic low-temperature test

6.1 General

This test is applicable to all rotary shaft lip-type seals for which the minimum specified operating temperature is stated to be −10 °C or lower.