SLOVENSKI STANDARD
SIST ISO 7986:1998

01-december-1998

Fluidna tehnika - Hidravlika - Tesnilke - Standardni postopki preskušanja za ugotavljanje sposobnosti tesnilk v oljni hidravliki pri izmeničnem premočrtnem gibanju

Hydraulic fluid power -- Sealing devices -- Standard test methods to assess the performance of seals used in oil hydraulic reciprocating applications

Transmissions hydrauliques -- Dispositifs d'étanchéité -- Méthodes d'essai normalisées d'évaluation des performances des joints utilisés dans des applications alternatives à l'huile hydraulique

Ta slovenski standard je istoveten z: **ISO 7986:1997**

ICS:

23.100.60	Filtri, tesnila in onesnaževanje tekočin	Filters, seals and contamination of fluids

SIST ISO 7986:1998 **en**

INTERNATIONAL STANDARD

ISO 7986

First edition
1997-07-15

Hydraulic fluid power — Sealing devices — Standard test methods to assess the performance of seals used in oil hydraulic reciprocating applications

Transmissions hydrauliques — Dispositifs d'étanchéité — Méthodes d'essai normalisées d'évaluation des performances des joints utilisés dans des applications alternatives à l'huile hydraulique

Reference number
ISO 7986:1997(E)

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X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

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.

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.

International Standard ISO 7986 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 7, *Sealing devices*.

Annexes A, B and C form an integral part of this International Standard. Annex D is for information only.

Introduction

0.1 General

It is widely recognized that the results from reciprocating seal testing can be unpredictable. The background research carried out in support of the preparation of this International Standard has demonstrated that this unpredictability is primarily a function of lack of control of critical variables affecting seal installation and operation. In order to carry out direct comparisons of seal performance, it is necessary to control these variables to closer limits than may be normal in industrial practice. The major variables that can affect seal performance, often even within normal manufacturing tolerance ranges, are listed in subclause 0.3.

0.2 Purpose of the test

The purpose of the test is to provide comparative data on individual reciprocating shaft seal designs and to provide a basis for the preliminary selection of seals based on their relative performance. To achieve this, it is necessary to carry out the tests under strictly defined operating conditions. This International Standard therefore defines standard values of speed, pressure, temperature and surface finish. This will permit comparison of seal test results from sources worldwide.

To make the test results as useful as possible, a range of operating conditions has been provided, so that the most appropriate conditions can be selected as a basis for comparison for initial seal selection.

The pressures are standard working pressures, selected from ISO 2944:1974, 6,3 MPa (63 bar[1]), 16 MPa (160 bar), and 31,5 MPa (315 bar).

The speeds have been selected to include slow speed (where stick-slip and high wear may be problems), medium speed for general purpose hydraulics and a representative high speed.

The constraints on installation and operation in this procedure have been proved by research (primarily carried out at BHR Group in the United Kingdom, under sponsorship from European companies) and international round robin seal tests to be necessary to achieve repeatable results. Any departure from the standard operating conditions and installation criteria cannot be considered a standard test.

1) 1 bar = 0,1 MPa = 10^5 Pa.

0.3 Factors affecting seal performance

Factors affecting seal performance include:

a) installation;

- sealing system, i.e., design of bearing(s), seal(s) and wiper seal;
- installation tolerances, including seal groove, shaft and bearings, extrusion gap;
- shaft material and hardness;
- surface finish of the shaft; variations of surface finish outside the range of *Ra* 0,08 µm to *Ra* 0,015 µm, or greater than *Rt* 1,5 µm, can significantly affect seal performance. Different seal materials also have significantly varying requirements for the optimum surface finish;
- surface finish of the groove surfaces. This must be less than *Ra* 0,8 µm to avoid static leakage and wear of the seal during pressure cycles;
- bearing material, including its effects on shaft texture and boundary layer.

b) operation;

- fluid, i.e., viscosity, lubricity, compatibility with seal material, including additives and contamination level;
- pressure, including pressure cycle;
- speed, especially speed cycle;
- speed/pressure cycle, i.e., stop-start conditions;
- stroke, especially short strokes (two times the seal contact widths or less), which prevent formation of a lubricant film;
- temperature, i.e., its effect on viscosity and seal material properties;
- external environment.

It is necessary to consider all the above factors and their potential effect on seal performance when comparing potential seal performance in an actual application to results obtained from the standard test.

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Hydraulic fluid power — Sealing devices — Standard test methods to assess the performance of seals used in oil hydraulic reciprocating applications

1 Scope

This International Standard defines the test conditions and methods for assessing the performance of seals used in oil hydraulic reciprocating applications.

The resulting specified characteristics may be published in manufacturer's literature to enable a direct comparison of seal performance.

The seal under test may be a single seal or a combination seal package.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO 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 1052:1982, *Steels for general engineering purposes.*

ISO 1629:1995, *Rubber and latices — Nomenclature.*

ISO 2944:1974, *Fluid power systems and components — Nominal pressures.*

ISO 3274:1996, *Geometrical Product Specification (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments.*

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

ISO 6743-4:1982, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems).*

ISO 10766:1996, *Hydraulic fluid power — Cylinders — Housing dimensions for rectangular-section-cut bearing rings for pistons and rods.*

3 Symbols

See table 1.

Table 1 — Symbols, quantities and units

Symbol	Quantity	Unit
d	Seal lip inside diameter	mm
D	Nominal seal housing diameter	mm
E	Seal length	mm
F	Friction force	N
d_h	Seal heel inside diameter	mm
l	Leakage	ml
L	Seal housing length	mm
p_{test}	Test pressure (forward stroke)	MPa
p_{return}	Return pressure (return stroke)	MPa
S_l	Radial seal section – lip	mm
S_h	Radial seal section – heel	mm
v	Test speed	m/s
W	Leakage collection zone	mm
Ra	Shaft surface texture, arithmetical mean deviation	µm
Rt	Shaft surface texture, total height of the surface profile	µm

4 Test installation

4.1 General

4.1.1 The tests described in this specification shall be conducted using a suitable test rig possessing the features shown in figure 1 and detail assembly as shown in figure 2.

4.1.2 The bearing housing shall be designed and constructed as detailed in figure 3 and figure 4 and shall be made of steel. Bearing material shall be polyester fabric/polyester material and shall contain no glass, ceramic, metallic or other potentially abrasive filler. The bearing shall comply with ISO 10766.

4.1.3 A circuit comprising components capable of cycling the pressure and controlling the flow to the specifications given in table 2 shall be provided to circulate the test fluid through the test seal housing.

Table 2 — Circuit specification

Characteristic	Specification
Fluid flow	4 l/min to 10 l/min
Filtration	10 µm absolute (through which fluid is continuously circulated)
Fluid reservoir	20 l to 50 l
Filter change	after every 1 000 h test running
Test oil change	after every 3 000 h test running

New test oil shall be circulated through a new filter for 5 h prior to beginning a test with new oil.

4.2 Mechanical details

4.2.1 Test rig rod

A test rod complying with table 3 shall be used.

Table 3 — Test rod specification

Parameter	Specification
Diameter	36 mm, tolerance f8 (per ISO 286-2)
Material	Shaft material in accordance with ISO 1052, induction hardened before coating with hard chrome with a coating thickness of 0,015 mm to 0,03 mm
Surface texture	Ground and polished to *Ra* 0,08 to *Ra* 0,15 µm when measured in accordance with 9.1.1

4.2.2 Test rig stroke

The length of stroke shall be limited to 500 mm ± 20 mm.

4.2.3 Test seal housing dimensions

Housings for the test seals shall comply with the dimensions specified in figure 2.

4.2.4 Leakage collection and drain

4.2.4.1 Rod seal (see figures 1 and 2): At the atmospheric extremity of each seal beyond which a wiper seal is installed, a leakage zone, *W*, of 20 mm ± 5 mm shall be provided. Provision shall be made for the collection from within this zone of any leakage that has drained away, for subsequent measurement (see 4.2.4.2). The wiper seals shall be made of nitrile (NBR) rubber (see ISO 1629) with a hardness of 70 IRHD to 75 IRHD and shall conform with the dimensions given in figure 7. New wiper seals shall be installed for each test.

4.2.4.2 Drain: Leakage drains having a minimum bore of 6 mm shall be provided.

5 Test parameters

5.1 Test fluid

Test fluid shall be synthetic hydrocarbon hydraulic oil, poly-alpha-olefin ISO-L-HS 32 in accordance with ISO 6743-4. [An example of an oil that conforms to this specification is Mobil SHC 524 [2].]

5.2 Test fluid temperature

The temperature of the test fluid throughout the tests shall be maintained at 60 °C to 65 °C when measured in the centre of the pressure chamber. The test fluid temperature shall be measured with a suitable thermocouple at the position specified in figure 2.

5.3 Test housing rod bearings

Rod bearings as specified in 4.1.2 shall be used in housings that comply with figure 3 and ISO 10766.

2) This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalents products may be used if they can be shown to lead to the same results.