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Fluid power systems — O-rings —

Part 5: Suitability of elastomeric materials for industrial applications

Transmissions hydrauliques et pneumatiques — Joints toriques —
Partie 5: Matériaux élastomères convenant pour applications industrielles

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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 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 3601 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3601-5 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 7, *Sealing devices*.

ISO 3601 consists of the following parts, under the general title *Fluid power systems — O-rings*:

— *Part 1: Inside diameters, cross-sections, tolerances and size identification code*

— *Part 2: Housing dimensions for general applications*

— *Part 3: Quality acceptance criteria*

— *Part 4: Anti-extrusion devices (back-up rings)*

— *Part 5: Suitability of elastomeric materials for industrial applications*

Introduction

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. One component of such a system can be a toroidal sealing ring, an O-ring. This part of ISO 3601 evaluates the suitability of a number of elastomeric materials (rubber) which may be used for O-rings in industrial applications.

Fluid power systems — O-rings —

Part 5:
Suitability of elastomeric materials for industrial applications

1 Scope

This part of ISO 3601 evaluates the suitability of a number of elastomeric materials (rubber) which may be used for O-rings in industrial applications. It also indicates the ability of the materials to satisfy many of the requirements associated with fluid power components and systems and includes temperatures and fluid compatibility. Only materials which are in universal usage are specified, other compounds are available and can be specified. The required physical properties should be agreed upon between equipment manufacturer/user and O-ring manufacturer/supplier.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 3601. 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 3601 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 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 2230, *Rubber products — Guidelines for storage*

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

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

3 Terms and definitions

For the purposes of this part of ISO 3601, the terms and definitions given in ISO 5598 and the following apply.

3.1
rubber compound
homogenous mix of all the constituents of a rubber formulation

EXAMPLES Rubber gumstock, curing agents, accelerators, fillers, reinforcing agents.

4 Materials

O-rings are generally made of elastomeric materials based on synthetic rubbers as specified in Table 1.

Table 1 — Commonly used elastomeric materials for O-rings

Symbol (in accordance with ISO 1629)	**Basic elastomer**	**Nominal hardness (IRHD)** (see ISO 48)
NBR	Acrylonitrile-butadiene	70; 90
FKM	Fluorocarbon	70; 80
EPDM	Ethylene propylene diene	70; 80
VMQ	Silicone	70
ACM	Polyacrylate	70
HNBR	Hydrogenated NBR	70; 80
NOTE 1 Other hardnesses and materials are possible depending on the application. NOTE 2 It is pointed out that the physical properties, e.g. the hardness, measured on test pieces can be different from those measured on O-rings.		

5 Suitability for industrial applications

Table 2 indicates the compatibility of O-rings made of the materials given in Table 1 with a range of service fluids used in industrial applications. Although these have been grouped, they may vary in their compositions.

More details with regard to application and continuous service temperatures are to be agreed upon between the user and the manufacturer.

6 Storage

O-rings shall be stored in accordance with ISO 2230.

7 Identification statement (Reference to this part of ISO 3601)

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 3601:

"Elastomeric materials for O-rings in accordance with ISO 3601-5:2002, *Fluid power systems — O-rings — Part 5: Suitability of elastomeric materials for industrial applications*."

Table 2 — Suitability of elastomeric materials for industrial applications

Material [a]	Allowable low temperatures for the material [b] °C	Fluids based on mineral oil [c]				Fuels [c]		Fire resistant hydraulic fluids [c]				Enviromental fluids		Other service fluids [c]	
		Motor oils	Hypoid gear oils	Automatic transmission fluid	ISO 6743-4, HL, HM (Hydraulic oils)	Greases	Diesel fuel	Fuel for gasolene/petrol engines - normal	Fuel for gasolene/petrol engines - super	ISO 6743-4, HFA fluids (oil-in-water emulsion)	ISO 6743-4, HFB fluids (water-in-oil emulsion)	ISO 6743-4, HFC fluids (water polymer solutions)	ISO 6743-4, HFDR fluids (phosphate esters)	ISO 6743-4, HFDS fluids (chlorinated hydrocarbons)	ISO 6743-4, HFDT fluids (mixtures of HFDR/HFDS)	ISO 6743-4, HETG (vegetable oils)	ISO 6743-4, HEES (synthetic ester)	ISO 6743-4,HEPG (polyglycol)	Water/steam	Air	Brake fluids
		Maximum continuous temperature in fluid °C [b]																			
NBR 70 IRHD NBR 90 IRHD	– 30	100	90	100	100	100	d	d	d	60	60	60	NS [e]	NS	NS	80	60	60	80	100	NS
FKM 70 IRHD	– 15	150	150	150	150	100	150	150	150	60	60	NS	150	150	150	80	100	80	100	200	NS
EPDM 70 IRHD	– 40	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	80	80	NS	NS	NS	NS	NS	140	130	130
VMQ 70 IRHD	– 50	d	d	d	d	100	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	100	200	80
HNBR 70 IRHD	– 30	130	110	130	130	100	d	d	d	60	60	60	NS	NS	NS	80	60	80	130	130	NS
ACM 70 IRHD	– 20	130	110	130	130	100	NS	NS	NS	NS	NS	NS	d	d	d	NS	NS	NS	NS	130	NS

NOTE 1 In respect of the material characteristics which vary from one manufacturer to another, only basic properties and fields of application have been specified.

NOTE 2 Data on material characteristics is available from the manufacturer.

NOTE 3 The specifier is to ensure that the selected elastomer will satisfy the required conditions of the application under which their equipment is designed to operate.

[a] The materials specified characterize a particular type of elastomer. From the basic elastomer, a number of mixtures may be prepared which exhibit similar basic characteristics but differ widely in their specific properties (e.g. tensile strength, elongation at break, rebound resilience, compression set and resistance to low and high temperatures).

[b] The information on service temperatures has been given for guidance only. It should be noted that, if the upper temperature limit is exceeded, a shorter service life may be expected. On the other hand, it may be necessary to lower this limit when using aggressive service fluids.

The fact that elastomeric material, when exposed to low temperatures, usually tends to exhibit excessive hardening without embrittlement, does not allow conclusions to be drawn on the service temperature since this is a function of other factors and should be agreed upon between the user and the manufacturer. There are special materials for use at lower temperatures.

[c] Although the behaviour of a mixture towards service fluids is mainly a function of the basic elastomer, the nature and the quantity of the other mixture components, such as plasticizers, fillers, curing agents and antioxidants are of relevance. Large quantities of extractable plasticizers, for example, may change the swelling properties of the elastomer so that it swells substantially less or even shrinks when used in mineral oils or solvents. Therefore, the data given is for general information only and intended to facilitate the selection of seal material for particular applications. In case of doubt, the manufacturer should be contacted.

[d] The elastomers of this group exhibit a different behaviour towards all or particular service fluids.

[e] NS denotes that the elastomer is not suitable for this group of service fluids.

Bibliography

[1] ISO 1629, *Rubber and latices — Nomenclature*