INTERNATIONAL STANDARD

ISO 16010

First edition
2005-07-15

Elastomeric seals — Material requirements for seals used in pipes and fittings carrying gaseous fuels and hydrocarbon fluids

Garnitures d'étanchéité en élastomères — Exigences matérielles pour les joints utilisés dans les canalisations et les raccords véhiculant des combustibles gazeux et des hydrocarbures liquides

Reference number
ISO 16010:2005(E)

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Published in Switzerland

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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 16010 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

Elastomeric seals — Material requirements for seals used in pipes and fittings carrying gaseous fuels and hydrocarbon fluids

1 Scope

This International Standard specifies requirements for elastomeric materials used in seals for supply pipes and fittings, ancillaries and valves at operating temperatures in general from –5 °C up to 50 °C and in special cases from –15 °C up to 50 °C, for the following:

a) general applications (see Table 4, type G series):

— gaseous fuel [manufactured, natural and liquefied petroleum gas (LPG) in the gaseous phase],

— hydrocarbon fluids with an aromatic content up to 30 % (by volume), including LPG in the liquid phase;

b) special applications (see Table 4, type H):

— materials suitable for carrying gaseous fuels containing gas condensates and hydrocarbon fluids of unrestricted aromatic content.

General requirements for finished joint seals are also given; any additional requirements called for by the particular application are specified in the relevant product standards, taking into account that the performance of pipe joints is a function of the seal material properties, seal geometry and pipe joint design. This International Standard should be used where appropriate with product standards which specify performance requirements for joints.

This International Standard is applicable to joint seals for all pipeline materials, including iron, steel, copper and plastics.

In the case of composite sealing rings, the requirements in 4.2.8 and 4.2.9 apply only when the materials used for any elastomeric parts come into contact with gaseous fuel or hydrocarbon fluid.

Elongation at break, tensile strength, compression set and stress relaxation requirements for materials of hardness classes 80 and 90 apply only when they constitute that part of the seal which participates directly in the sealing function or contributes directly to long-term stability.

This International Standard is not applicable to the following:

— seals made from cellular materials;

— seals with enclosed voids as part of their design;

— seals required to be resistant to flame or to thermal stress;

— seals which contain splices joining pre-vulcanized profile ends.

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 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

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

ISO 188:1998, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 815, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures*

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

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

ISO 3302-1, *Rubber — Tolerances for products — Part 1: Dimensional tolerances*

ISO 3384:2005, *Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression at ambient and at elevated temperatures*

ISO 9691:1992, *Rubber — Recommendations for the workmanship of pipe joint rings — Description and classification of imperfections*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Classification

Five classes of material for pipe seals are specified in Tables 2 and 3.

A nominal hardness shall be specified within the ranges in Table 1.

Table 1 — Hardness classification

Hardness class	50	60	70	80	90
Range of hardness, IRHD	46 to 55	56 to 65	66 to 75	76 to 85	86 to 95

4 Requirements

4.1 Materials

The materials shall be free of any substances which may have a deleterious effect on the life of the seals, or on the pipe or fittings.

4.2 Finished-seal requirements

4.2.1 Dimensional tolerances

Tolerances shall be specified from the appropriate classes in ISO 3302-1.

4.2.2 Imperfections and defects

The seals shall be free of defects or irregularities which could affect their function. Classification of imperfections shall be in accordance with ISO 9691, as follows:

— surface imperfections in zones involved in the sealing function as described in Subclause 4.1.1 of ISO 9691:1992 shall be considered as defects;

— minor surface imperfections in zones not involved in the sealing function as described in 4.1.2.1 b) of ISO 9691:1992 shall not be considered as defects.

Major surface imperfections in zones not involved in the sealing function as described in 4.1.2.1 a) of ISO 9691:1992 can be considered as defects. This shall be agreed between the interested parties; the acceptance criteria will depend upon the seal type or design.

Internal imperfections as described in Subclause 4.2 of ISO 9691:1992 could be considered as defects. The compressive force can be determined in accordance with ISO 7743. The acceptable limiting values of the compressive force shall be agreed between the interested parties; they will depend upon the seal type or design.

4.2.3 Hardness

When determined by the micro-test specified in ISO 48, the hardness shall comply with the requirements given in Table 2 or 3.

NOTE If the dimensions of a seal are appropriate, the normal test method specified in ISO 48 can be used, provided that the micro-test method is used for referee purposes.

For the same seal, the difference between the minimum and maximum hardness values shall not be more than 4 IRHD. Each value shall be within the specified tolerances.

4.2.4 Tensile strength and elongation at break

Tensile strength and elongation at break shall be determined by the method specified in ISO 37. Dumb-bell shaped test pieces of type 1, 2, 3 or 4 shall be used. Type 2 is the preferred type. The test report shall state the dumb-bell type whenever type 2 is not used.

The tensile strength and the elongation at break shall comply with the requirements given in Table 2 or 3.

4.2.5 Compression set in air

4.2.5.1 General

If the test piece is taken from a seal, then the measurement shall be carried out as far as possible in the direction of compression of the seal in service.

4.2.5.2 Compression set at 23 °C and 70 °C

When determined by the method specified in ISO 815, at 23 °C and 70 °C using the small type B test piece, the compression set shall comply with the requirements given in Table 2 or 3.

If the cross-section of a seal is too small to obtain suitable test pieces, a type B test piece can be prepared either by cutting from a test slab or by moulding a disc (see 5.1).

4.2.5.3 Low-temperature compression set at –5 °C

When determined by the method specified in ISO 815 using the small type B test piece and a recovery time of (30 ± 3) min, the compression set after 72 h at –5 °C, when measured at –5 °C, shall comply with the requirements given in Table 2 or 3.

4.2.6 Accelerated ageing in air

Test pieces prepared for the determination of hardness (see 4.2.3) and for the determination of tensile strength and elongation at break (see 4.2.4) shall be aged in air at 70 °C for 7 days by the normal oven method specified in ISO 188:1998 (method A).

The changes in hardness, tensile strength and elongation at break shall comply with the requirements given in Table 2 or 3.

4.2.7 Stress relaxation in compression

The stress relaxation shall be determined by method A of ISO 3384:2005, using a test piece in accordance with 5.1, after applying mechanical and thermal conditioning. Measurements shall be taken after 3 h, 1 day, 3 days and 7 days for the 7-day test and after 3 h, 1 day, 3 days, 7 days, 30 days and 90 days for the 90-day test. The best-fit straight line shall be determined by regression analysis using a logarithmic time scale, and the correlation coefficients derived from this analysis shall not be lower than 0,93 for the 7-day test and 0,83 for the 90-day test. The 7-day and 90-day requirements in Tables 2 and 3 are those derived from these straight lines.

For continuous measurement using an apparatus as described in the first paragraph of 5.2 of ISO 3384:2005, the 7-day and 90-day requirements in Tables 2 and 3 are those derived from the measurements at 7 days and 90 days.

The stress relaxation in compression shall comply with the requirements given in Table 2 or 3 at the following temperatures and times:

— 7 days at (23 ± 2) °C;

— 90 days at (23 ± 2) °C.

The test temperature shall be maintained within the specified tolerance during the whole period of the test and verified by suitable recording equipment on a continuous basis.

The 90-day test shall be considered as a type approval test.

If the test piece is taken from a seal, then the measurement shall be carried out as far as possible in the direction of compression of the seal in service.

4.2.8 Volume change in liquid B

When determined by the method specified in ISO 1817, the volume change after 7 days immersion at 23 °C in liquid B and, in addition, followed by drying in air for 4 days at 70 °C, shall comply with the requirements given in Table 2 or 3.

4.2.9 Volume change in oil

When determined by the method specified in ISO 1817, after 7 days immersion at 70 °C in standard oil No. 3, the volume change shall comply with the requirements given in Table 2 or 3.

4.2.10 Ozone resistance

When determined by the method specified in ISO 1431-1, under the conditions set out below:

— ozone concentration		(50 ± 5) pphm
— temperature		(40 ± 2) °C
— pre-tension time		$72\ ^{0}_{-2}$ h
— exposure time		$48\ ^{0}_{-2}$ h
— elongation:	hardness classes 50, 60 and 70	(20 ± 2) %
	hardness class 80	(15 ± 2) %
	hardness class 90	(10 ± 1) %
— relative humidity		(55 ± 10) %

the test piece shall comply with the requirements given in Table 2 or 3.

Sealing elements which are protected by packaging, whether packaged separately or not, up to the time of installation shall meet the same requirement but using an ozone concentration of (25 ± 5) pphm.

4.2.11 Compression set at –15 °C

When determined by the method specified in ISO 815 using the small type B test piece and a recovery time of (30 ± 3) min, the compression set of elastomeric materials which are intended to be used at temperatures below –5 °C and down to –15 °C shall after 72 h at –15 °C, when measured at –15 °C, comply with the requirements given in Table 2.

5 Test pieces and temperature

5.1 Preparation of test pieces

Unless otherwise specified, test pieces shall be cut from the finished product by the method specified in ISO 23529. If satisfactory test pieces cannot be prepared in accordance with the instructions given for the appropriate test method, they shall be taken from test slabs or sheets of suitable dimensions or shall be moulded in a suitable cavity. They shall be made from the same batch of the elastomer mix as used to make the seals and moulded under conditions which are comparable with those used in production.

For tests in which different sizes of test piece are permissible, the same size of test piece shall be used for each batch and for any comparative purposes.

5.2 Test temperature

Unless otherwise specified, tests shall be carried out at a standard temperature in accordance with ISO 23529.

NOTE Two standard laboratory temperatures are given in ISO 23529, but the recommended test temperature (if not already specified) in this International Standard is 23 °C.