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Elastomeric seals — Requirements for materials for pipe joint seals used in water and drainage applications — Thermoplastic elastomers

Garnitures d'étanchéité en caoutchouc — Spécification des matériaux pour garnitures d'étanchéité utilisées dans le domaine de l'eau et du drainage — Élastomères thermoplastiques

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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 23711 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

Elastomeric seals — Requirements for materials for pipe joint seals used in water and drainage applications — Thermoplastic elastomers

1 Scope

This International Standard specifies requirements for materials used for moulded seals made of thermoplastic elastomers (TPEs) for joints in:

a) thermoplastic piping systems for non-pressure waste water discharge (intermittent flow at up to 95 °C) inside buildings;

b) thermoplastic piping systems for non-pressure underground drainage and sewerage (continuous flow at up to 45 °C and intermittent flow at up to 95 °C);

c) thermoplastic rainwater piping systems.

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.

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

ISO 471, *Rubber — Temperatures, humidities and times for conditioning and testing*

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 strain test*

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

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

ISO 3384:1999, *Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression at ambient and at elevated temperatures*

ISO 4661-1, *Rubber, vulcanized or thermoplastic — Preparation of samples and test pieces — Part 1: Physical tests*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
thermoplastic elastomer
a polymer or blend of polymers that does not require vulcanization or cross-linking during processing, yet has elastic properties at its service temperature

NOTE These properties disappear at processing temperature, so that further processing is possible, but return when the material is returned to its service temperature.

4 Classification

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

Table 1 — Hardness classification

Hardness class	50	60	70
Range of hardness, IRHD	46 to 55	56 to 65	66 to 75

The three classes of hardness for materials for pipe joint seals are specified in Table 2.

5 Finished-seal requirements

5.1 Dimensional tolerances

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

5.2 Imperfections and defects

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

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

— 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.

NOTE 1 Major surface imperfections in zones not involved in the sealing function as described in 4.1.2.1 a) of ISO 9691:1992 could be considered as defects. This should be agreed between the interested parties; the acceptance criteria depend upon the seal type or design.

NOTE 2 Internal imperfections as described in 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 should be agreed between the interested parties; they depend upon the seal type or design.

5.3 Hardness

When determined by the microtest method specified in ISO 48, on samples prepared in accordance with 6.1.2, the hardness shall comply with the requirements given in Table 2.

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

For the same seal, the difference between the minimum and maximum hardness values shall not be more than 5 IRHD. Each value shall be within the specified tolerances.

5.4 Tensile strength and elongation at break

The tensile strength and elongation at break shall be determined by the method specified in ISO 37 in the direction perpendicular to the mould flow on dumb-bell test pieces, preferably cut out of a seal or out of a sample plate. The results obtained on sample plate test pieces shall be accepted.

Sample plates shall be prepared as specified in 6.1.1 and 6.1.3. The tensile strength and elongation at break shall comply with the requirements given in Table 2.

5.5 Compressive set in air

5.5.1 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 at 25 % compression.

5.5.2 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.

5.5.3 Low temperature compression set at −10 °C

When determined by the method specified in ISO 815 at −10 °C, using the small type B test piece, and the (30 ± 3) min recovery measurement, the compression set of seals used in drainage and sewerage applications shall comply with the requirements given in Table 2.

5.6 Accelerated ageing in air

Test pieces prepared for the determination of hardness according to 5.3 and for the determination of tensile strength and elongation at break (see 5.4) shall be aged in air by the normal oven method specified in ISO 188, for 7 days at 70 °C.

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

5.7 Stress relaxation in compression

The stress relaxation shall be determined at 23 °C by method A of ISO 3384:1999 using the small cylindrical test piece 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 100 days for the 100-day test. The best-fit straight line shall be determined by regression analysis using a logarithmic time scale and the correlation coefficients derived from these analyses shall not be lower than 0,93 for the 7-day test and 0,83 for the 100-day test. The 7-day and 100-day requirements in Table 2 are those derived from these straight lines.

For continuous measurement using an apparatus described in the first paragraph of 5.2 in ISO 3384:1999, the 7-day and 100-day requirements in Table 2 are those derived from the measurements at 7 days and 100 days.

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

— 7 days at (23 ± 2) °C;

— 100 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 100-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.

5.8 Volume change in water

When determined by the method specified in ISO 1817, after 7 days' immersion of test pieces in distilled or deionized water at a temperature of 70 °C, the change in volume shall comply with the requirements given in Table 2.

5.9 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;

— Pretension time (72 + 0/-2) h;

— Exposure time (48 + 0/-2) h;

— Elongation (20 ± 2) %;

— Relative humidity (55 ± 10) %.

The ozone resistance of thermoplastic elastomer sealing elements which are attached to the pipe or fittings shall comply with the requirements given in Table 2.

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.

5.10 Change in volume in oil (for type WH only)

When determined in accordance with ISO 1817, the change in volume after immersion in oil No. 1 for 72 h at 70 °C shall comply with the requirements given in Table 2.

Table 2 — Physical-property requirements for type WT and WH thermoplastic-elastomer (TPE) materials (see Table 3) for seals used in thermoplastic non-pressure and rainwater piping systems

Property	Unit	Test method	Subclause	Requirements for hardness classes		
				50	60	70
Permissible tolerance on nominal hardness	IRHD	ISO 48 (microtest)	5.3	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	5.4	3	4	5
Elongation at break, min.	%	ISO 37	5.4	300	300	300
Compression set, max.						
— 72 h at 23 °C	%	ISO 815	5.5.2	25	25	25
— 24 h at 70 °C	%	ISO 815	5.5.2	40	40	40
— 72 h at –10 °C	%	ISO 815	5.5.3	65	65	65
Ageing, 7 days at 70 °C		ISO 188	5.6			
— hardness change, max.	IRHD	ISO 48		±5	±5	±5
— tensile strength change, max.	%	ISO 37		±10	±10	±10
— elongation change, max.	%	ISO 37		±15	±15	±15
Stress relaxation, max.						
— 7 days at 23 °C	%	ISO 3384	5.7	19	22	24
— 100 days at 23 °C	%	ISO 3384	5.7	28	32	35
Volume change in water, max. (7 days at 70 °C)	%	ISO 1817	5.8	$^{+8}_{-1}$	$^{+8}_{-1}$	$^{+8}_{-1}$
Ozone resistance	—	ISO 1431-1	5.9	No cracking when viewed without magnification		
Additional requirement for type WH						
Volume change in oil, max. (72 h at 70 °C in oil No. 1)	%	ISO 1817	5.10	$^{+50}_{-10}$	$^{+50}_{-10}$	$^{+50}_{-10}$

6 Test pieces and temperature

6.1 Preparation of test pieces

6.1.1 General

Unless otherwise specified, test pieces shall be cut from the finished product by the method specified in ISO 4661-1. 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 be moulded in a suitable cavity. They shall be made from the same batch of the elastomer mix 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.

6.1.2 Test pieces for determination of hardness

Test slabs or sheets shall be injection moulded in an appropriate mould under conditions simulating as closely as possible the actual seal-moulding conditions. The hardness measurement shall be carried out on a test