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**Rubber seals — Joint rings for  
pipelines for hot-water supply up to  
110 °C — Specification for the material**

*Jointes étanches en caoutchouc — Garnitures d'étanchéité destinées  
aux joints de canalisations pour la fourniture d'eau chaude jusqu'à  
110 °C — Spécifications pour les matériaux*





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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

This third edition cancels and replaces the second edition (ISO 9631:2003), which has been technically revised.

The main changes compared to the previous edition are as follows.

- Three different temperature classes (T1, T2 and T3) have been introduced. The requirements for the lowest class (T1) are similar to the requirements in the second edition of this standard, while classes T2 and T3 have been added in [Table 2](#) to specify more severe requirements in order to deal with more demanding applications.
- The test procedure for the hot water compression set ([Annex B](#)) has been revised to be more in line with experiences over the last years.

# Rubber seals — Joint rings for pipelines for hot-water supply up to 110 °C — Specification for the material

**WARNING** — Persons using this document should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices.

## 1 Scope

This document specifies material requirements for vulcanized rubber seals for hot drinking and non-drinking water supply (up to 110 °C).

The different seal designations specified are defined according to seal type, seal application and the requirements for a particular seal (see [Table 2](#)).

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 document is intended to be used where appropriate, in conjunction with product standards which specify performance requirements for joints.

This document is applicable to joint seals for use with all pipeline materials, including metals, clay, fibre cement, concrete, reinforced concrete, plastics and glass-reinforced plastics.

It is applicable to elastomeric components of composite and non-composite seals. In the case of composite seals made from materials with hardness ranging from 76 IRHD to 95 IRHD, the requirements for elongation at break, compression set and stress relaxation apply only when the material participates in the sealing function or contributes to the long-term stability of the seal.

The material requirements specified in this document are designed for long term performances and a potential lifetime of 50 years. The lifetime of a sealing depends not only on material performance but also on other parameters which are not defined in this document like the mounting design, the quality of assembly and the combination with operating conditions. Joint rings made from cellular rubber materials are not covered by this document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 34-2, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 2: Small (Delft) test pieces*

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 188:2011, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

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

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



ISO 1629, *Rubber and latices — Nomenclature*

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

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

ISO 3384-1:2011, *Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression — Part 1: Testing at constant temperature*

ISO 6914:2013, *Rubber, vulcanized or thermoplastic — Determination of ageing characteristics by measurement of stress relaxation in tension*

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

ISO 10508:2006, *Plastics piping systems for hot and cold water installations — Guidance for classification and design*

ISO 15510, *Stainless steels — Chemical composition*

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

### 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 4 Classification

4.1 Materials for pipe joint seals are classified based on their nominal hardness. 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

4.2 On top of that, three classes for the use of the materials are specified in [Table 2](#).

**Table 2 — Classes and designation of elastomeric joint seals by type, application and requirements**

Class	Application	Requirements	Subclause
T1	Hot water systems where the temperature is high (up to 85 °C) during tapping and low (ambient) when no water is used.	<a href="#">Tables 3 and 4</a> (Effect on water quality)	<a href="#">5.1.2</a>
T2	Hot water circulation systems based on the classification class 2 in ISO 10508:2006	<a href="#">Tables 5 and 6</a> (Effect on water quality)	<a href="#">5.1.2</a>
T3	District heating, secondary systems with hot water circulation between 75 °C and 95 °C <sup>a</sup>	<a href="#">Tables 7 and 8</a> (Effect on water quality)	<a href="#">5.1.2</a>

<sup>a</sup> T3 is based on EN 253.

A material of one type qualified for one class is automatically qualified for the inferior class.

**4.3** Furthermore a difference is made for two types of sealing principle:

- Type A: Seals based on EPM, EPDM, NBR, SBR or equivalent polymers as typical materials;
- Type B: Seals based on IIR, CIIR or BIIR (butylic rubbers) or equivalent as typical materials.

**4.4** If products are intended for drinking water, the letter D is added to the designation.

## 5 Requirements and test methods

### 5.1 Requirements for material

#### 5.1.1 General

Requirements are summarized in [Tables 3, 4, 5, 6, 7](#) and [8](#) for each class. The material shall be free of any substances which could have a deleterious effect on the water transported, or on the life of the sealing ring, or on the pipe or fitting. Elastomeric components of composite seals not exposed to the contents of the pipeline are not required to meet the requirements of [5.1.2](#).

**Table 3 — Physical-property requirements for type A materials used in class T1 applications**

Property	Unit	Test method	Sub-clause	Requirements for hardness classes				
				50	60	70	80	90
Permissible tolerance on nominal hardness	IRHD	ISO 48	<a href="#">5.2.3</a>	±5	±5	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	<a href="#">5.2.4</a>	9	9	9	9	9
Elongation at break, min.	%	ISO 37	<a href="#">5.2.4</a>	250	200	150	100	100
Compression set, max.	%	ISO 815-1	<a href="#">5.2.5.2</a>	15	15	15	15	15
72 h at 23 °C	%	ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20	20	20
24 h at 125 °C	%	ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20	20	20
Ageing, 7 days at 125 °C	IRHD	ISO 188	<a href="#">5.2.6</a>					
Hardness change, max.	%	ISO 48		+8/-5	+8/-5	+8/-5	+8/-5	+8/-5
Tensile strength change, max.	%	ISO 37		-20	-20	-20	-20	-20
Elongation change, max.	%	ISO 37		+10/-30	+10/-30	+10/-30	+10/-40	+10/-40
Stress relaxation, max	%	ISO 3384-1	<a href="#">5.2.7</a>					
7 days at 23 °C		or		15	15	15	18	18
7 days at 125 °C		ISO 6914		30	30	30	30	30
Volume change in water, max.	%	ISO 1817	<a href="#">5.2.8</a>	+8/-1	+8/-1	+8/-1	+8/-1	+8/-1
7 days at 95 °C								
Ozone resistance	—	ISO 1431-1	<a href="#">5.2.9</a>	No cracking when viewed without magnification				
Tear strength, min.	N	ISO 34-2	<a href="#">5.2.10</a>	20	20	20	20	20

Table 4 — Physical-property requirements for type B materials used in class T1 applications

Property	Unit	Test method	Sub-clause	Requirements for hardness classes			
				50	60	70	80
Permissible tolerance on nominal hardness	IRHD	ISO 48	<a href="#">5.2.3</a>	±5	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	<a href="#">5.2.4</a>	9	9	9	9
Elongation at break, min.	%	ISO 37	<a href="#">5.2.4</a>	250	200	150	100
Compression set, max.	% % %	ISO 815-1	<a href="#">5.2.5.2</a>	15	15	15	15
72 h at 23 °C		ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20	20
24 h at 125 °C		ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20	20
Ageing, 7 days at 125 °C	IRHD % % %	ISO 188	<a href="#">5.2.6</a>				
Hardness change, max.		ISO 48		+8/-5	+8/-5	+8/-5	+8/-5
Tensile strength change, max.		ISO 37		-20	-20	-20	-20
Elongation change, max.		ISO 37		+10/-30	+10/-30	+10/-30	+10/-40
Stress relaxation, max 7 days at 23 °C	%	ISO 3384-1 or ISO 6914	<a href="#">5.2.7</a>	15	15	15	18
Ozone resistance	—	ISO 1431-1	<a href="#">5.2.9</a>	No cracking when viewed without magnification			
Compression set in water for 1 680 h at 110 °C, max.	%	<a href="#">Annex B</a>	<a href="#">5.2.11</a>	30	30	30	30

Table 5 — Physical-property requirements for type A materials used in class T2 applications

Property	Unit	Test method	Sub-clause	Requirements for hardness classes		
				60	70	80
Permissible tolerance on nominal hardness	IRHD	ISO 48	<a href="#">5.2.3</a>	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	<a href="#">5.2.4</a>	9	9	9
Elongation at break, min.	%	ISO 37	<a href="#">5.2.4</a>	200	150	100
Compression set, max.	% % %	ISO 815-1	<a href="#">5.2.5.2</a>	15	15	15
72 h at 23 °C		ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20
24 h at 125 °C		ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20
Ageing, 7 days at 125 °C	IRHD % % %	ISO 188	<a href="#">5.2.6</a>			
Hardness change		ISO 48		+8/-5	+8/-5	+8/-5
Tensile strength change, max.		ISO 37		-20	-20	-20
Elongation change		ISO 37		+10/-30	+10/-30	+10/-40
Stress relaxation, max 7 days at 23 °C	%	ISO 3384-1 or ISO 6914	<a href="#">5.2.7</a>	15	15	18
7 days at 125 °C		ISO 6914		30	30	30
Stress relaxation, max. 21 days at 140 °C	%	ISO 6914	<a href="#">5.2.7</a>	55	55	55
Volume change in water 7 days at 95 °C	%	ISO 1817	<a href="#">5.2.8</a>	+8/-1	+8/-1	+8/-1



Table 5 (continued)

Property	Unit	Test method	Sub-clause	Requirements for hardness classes		
				60	70	80
Ozone resistance	—	ISO 1431-1	<a href="#">5.2.9</a>	No cracking when viewed without magnification		
Tear strength, min.	N	ISO 34-2	<a href="#">5.2.10</a>	20	20	20
Compression set in water at 110 °C	%	<a href="#">Annex B</a>	<a href="#">5.2.11</a>			
After 3 000 h or else				<20	<20	<20
After 10 000 h				<40	<40	<40

Table 6 — Physical-property requirements for type B materials used in class T2 applications

Property	Unit	Test method	Sub-clause	Requirements for hardness classes		
				60	70	80
Permissible tolerance on nominal hardness	IRHD	ISO 48	<a href="#">5.2.3</a>	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	<a href="#">5.2.4</a>	9	9	9
Elongation at break, min.	%	ISO 37	<a href="#">5.2.4</a>	200	150	100
Compression set, max.	%	ISO 815-1	<a href="#">5.2.5.2</a>			
72 h at 23 °C				15	15	15
24 h at 125 °C		ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20
Ageing, 7 days at 125 °C	IRHD	ISO 188	<a href="#">5.2.6</a>			
Hardness change		ISO 48		+8/-5	+8/-5	+8/-5
Tensile strength change, max.		ISO 37		-20	-20	-20
Elongation change		ISO 37		+10/-30	+10/-30	+10/-40
Stress relaxation, max	%	ISO 3384-1	<a href="#">5.2.7</a>			
7 days at 23 °C		or ISO 6914		15	15	18
Ozone resistance	—	ISO 1431-1	<a href="#">5.2.9</a>	No cracking when viewed without magnification		
Compression set in water for 10 000 h at 110 °C, max.	%	<a href="#">Annex B</a>	<a href="#">5.2.11</a>	40	40	40
Slope rate/1 000 h between 1 000 h and 10 000 h, max.				4	4	4

Table 7 — Physical-property requirements for type A materials used in class T3 applications

Property	Unit	Test method	Sub-clause	Requirements for hardness classes		
				60	70	80
Permissible tolerance on nominal hardness	IRHD	ISO 48	<a href="#">5.2.3</a>	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	<a href="#">5.2.4</a>	9	9	9
Elongation at break, min.	%	ISO 37	<a href="#">5.2.4</a>	200	150	100
Compression set, max.	%	ISO 815-1	<a href="#">5.2.5.2</a>			
72 h at 23 °C				15	15	15
24 h at 125 °C		ISO 815-1	<a href="#">5.2.5.2</a>	20	20	20

Table 7 (continued)

Property	Unit	Test method	Sub-clause	Requirements for hardness classes		
				60	70	80
Ageing, 7 days at 125 °C	IRHD % % %	ISO 188	<a href="#">5.2.6</a>			
Hardness change		ISO 48		+8/-5	+8/-5	+8/-5
Tensile strength change, max.		ISO 37		-20	-20	-20
Elongation change		ISO 37		+10/-30	+10/-30	+10/-40
Stress relaxation, max.	%	ISO 3384-1	<a href="#">5.2.7</a>			
7 days at 23 °C		or		15	15	18
7 days at 125 °C		ISO 6914		30	30	30
Stress relaxation, max.	%	ISO 6914	<a href="#">5.2.7</a>	55	55	55
28 days at 140 °C						
Volume change in water	%	ISO 1817	<a href="#">5.2.8</a>	+8/-1	+8/-1	+8/-1
14 days at 95 °C						
Ozone resistance	—	ISO 1431-1	<a href="#">5.2.9</a>	No cracking when viewed without magnification		
Tear strength, min	N	ISO 34-2	<a href="#">5.2.10</a>	20	20	20
Compression set in water at 110 °C	%	<a href="#">Annex B</a>	<a href="#">5.2.11</a>			
After 3 000 h or else				<20	<20	<20
After 10 000 h				<40	<40	<40

Table 8 — Physical-property requirements for type B materials used in class T3 applications

Property	Unit	Test method	Sub-clause	Requirements for hardness classes		
				60	70	80
Permissible tolerance on nominal hardness	IRHD	ISO 48	<a href="#">5.2.3</a>	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	<a href="#">5.2.4</a>	9	9	9
Elongation at break, min.	%	ISO 37	<a href="#">5.2.4</a>	200	150	100
Compression set, max.	%	ISO 815-1	<a href="#">5.2.5.2</a>	15	15	15
72 h at 23 °C		ISO 815-1		20	20	20
24 h at 125 °C						
Ageing, 7 days at 125 °C	IRHD % % %	ISO 188	<a href="#">5.2.6</a>			
Hardness change		ISO 48		+8/-5	+8/-5	+8/-5
Tensile strength change, max.		ISO 37		-20	-20	-20
Elongation change		ISO 37		+10/-30	+10/-30	+10/-40
Stress relaxation, max.	%	ISO 3384-1	<a href="#">5.2.7</a>			
7 days at 23 °C		or		15	15	18
		ISO 6914				
Ozone resistance	—	ISO 1431-1	<a href="#">5.2.9</a>	No cracking when viewed without magnification		
Compression set in water for 10 000 h at 110 °C, max.	%	<a href="#">Annex B</a>	<a href="#">5.2.11</a>	35	35	35
Slope rate 1 000 h between 1000 h and 10 000 h, max.				3	3	3

### 5.1.2 Effect on water quality

For hot drinking-water applications, the material shall not impair the quality of the water under the conditions of use.

NOTE Some countries have national requirements for the material.

## 5.2 Requirement for finished seals

### 5.2.1 Dimensional tolerances

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

### 5.2.2 Imperfections and defects

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

- surface imperfections in zones involved in the sealing function, as described in ISO 9691:1992, 4.1.1, shall be considered as defects;
- minor surface imperfections in zones not involved in the sealing function, as described in ISO 9691:1992, 4.1.2.1 b), shall not be considered as defects.

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

Internal imperfections as described in ISO 9691:1992, 4.2, 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 and design.

### 5.2.3 Hardness

When determined by the micro-test method specified in ISO 48, the hardness shall comply with the requirements given in [Tables 3, 4, 5, 6, 7 or 8](#). If the dimensions of a seal are suitable, the normal test method specified in ISO 48 may be used, provided that the micro-test method is used for reference purposes.

For a particular seal, or along the greatest length of an extruded profile cut to make the seal, the difference between the highest and lowest hardness values measured shall not be more than 5 IRHD. Each value shall be within the specified tolerance limits.

### 5.2.4 Tensile strength and elongation at break

The 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 being 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 [Tables 3, 4, 5, 6, 7 or 8](#).

### 5.2.5 Compression set in air

#### 5.2.5.1 General

If the test pieces are taken from a seal, then the measurements shall be carried out as far as possible in the direction of compression of the seal in service.



#### 5.2.5.2 Compression set at 23 °C and 125 °C

When determined by the method specified in ISO 815-1, at 23 °C and 125 °C, using the small (type B) test piece cut from the seal, the compression set shall comply with the requirements given in [Tables 3, 4, 5, 6, 7 or 8](#).

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 [6.1](#)). As an alternative, the tension set of the product may be determined using ISO 2285:2013, method A, with a strain of 50 % and applying the same test conditions (except strain) and requirements as for compression set.

#### 5.2.6 Accelerated ageing in air

Test pieces prepared for the determination of hardness (see [5.2.3](#)) and for the determination of tensile strength and elongation at break (see [5.2.4](#)) shall be aged in air using ISO 188:2011, method A, at 125 °C. The period of storage is given in [Tables 3, 4, 5, 6, 7 or 8](#).

The changes in hardness, tensile strength and elongation shall comply with the requirements given in [Tables 3, 4, 5, 6, 7 or 8](#).

#### 5.2.7 Stress relaxation

The stress relaxation at 23 °C and 125 °C shall be determined by ISO 3384-1:2011, method A, using the small cylindrical test piece after thermal and mechanical conditioning.

Carry out the 7-day test at 23 °C and at 125 °C, taking measurements after 3 h, 1 day, 3 days and 7 days at minimum.

Determine the best-fit straight line by regression analysis using a logarithmic time scale. The correlation coefficients derived from these analyses shall not be lower than 0,93. The 7-day requirements in [Tables 3, 4, 5, 6, 7 or 8](#) are those derived from these straight lines. If continuous measurements are made using the apparatus described in ISO 3384-1:2011, 5.2 (first paragraph), the 7-day requirements in [Tables 3, 4, 5, 6, 7 or 8](#) correspond to the measurement at 7 days.

The stress relaxation in compression shall comply with the requirements given in [Tables 3, 4, 5, 6, 7 or 8](#).

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.

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

If the cross-section of a seal is too small to obtain suitable test pieces, a test piece can be prepared either by cutting from a test slab or by moulding a disc (see [6.1](#)). As an alternative, the stress relaxation in tension of the product may be determined, using ISO 6914:2013, method A, with the same requirements as for stress relaxation in compression.

#### 5.2.8 Volume change in water

When determined by the method specified in ISO 1817 after the described period of immersion in distilled or deionized water at 95 °C the change in volume shall comply with the requirements given in [Tables 3, 4, 5, 6, 7 or 8](#).

#### 5.2.9 Ozone resistance

When determined by the method specified in ISO 1431-1 under the conditions set out in [Table 9](#), the ozone resistance of vulcanized-rubber sealing elements which are attached to the pipe or fittings shall comply with the requirement given in [Tables 3, 4, 5, 6, 7 or 8](#).



**Table 9 — Conditions for the ozone resistance test**

Partial pressure of ozone	(50 ± 5) mPa [approximately (50 ± 5) pphm]	
Temperature	(40 ± 2) °C	
Pre-tension time	72 <sup>0</sup> <sub>-2</sub> h	
Exposure time	48 <sup>0</sup> <sub>-2</sub> h	
Relative humidity	(55 ± 10) %	
Elongation	46 IRHD to 75 IRHD	(20 ± 2) %
	76 IRHD to 85 IRHD	(15 ± 2) %
	86 IRHD to 95 IRHD	(10 ± 1) %

Rubber sealing elements which are protected by packaging, whether packaged separately or not, from shortly after production (within 3 days after vulcanisation) up to the time of installation shall meet the same requirement but using an ozone concentration of (25 ± 5) mPa. In this case the letter 'O' is added to the designation.

Rubber sealing elements based on EPM, EPDM, VMQ, FKM or FEPDM, do not need to be tested.

#### 5.2.10 Tear strength

When determined by the method specified in ISO 34-2 at ambient temperature, the tear strength shall comply with the requirements given in [Tables 3, 4, 5, 6, 7 or 8](#).

#### 5.2.11 Compression set in water

When tested by the method given in [Annex B](#), the requirements of [Tables 4, 5, 6, 7 or 8](#) shall be fulfilled. For the calculation of the increase between 1 000 h and 10 000 h stipulated in [Tables 6 and 8](#) the slope shall be calculated using the best fit straight line by regression analyses. For the regression analyses, measurements should be taken at least every 1 000 h.

#### 5.2.12 Splices of prevulcanized profile ends

##### 5.2.12.1 Spliced joints

These shall be vulcanized.

##### 5.2.12.2 Strength of spliced joints

When tested by the method specified in [Annex A](#), there shall be no visible separation across the cross-section of the splice, when viewed without magnification.

## 6 Testing

### 6.1 Preparation of test pieces

Unless otherwise specified, test pieces shall be cut from finished products 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 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 pieces are permissible, the same size of test piece shall be used for each batch and for any comparative purposes.

## 6.2 Test temperature

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

## 7 Quality assurance

Quality assurance testing is not an integral part of this document, but guidance can be obtained from [Annex C](#) which recommends appropriate test frequencies, product control tests and sampling techniques.

A quality assurance system such as that described in ISO 9001 should be used.

## 8 Storage

See [Annex D](#).

## 9 Designation

Elastomeric seals for pipelines are designated according to their intended application as described in [Table 2](#). The following information shall be used for a full designation of the seals:

- |   |                   |
|---|-------------------|
| a) Description  | e.g. SEAL         |
| b) International Standard                             | i.e. ISO 9631     |
| c) Nominal size                                       | e.g. OD 150       |
| d) Type of application (see <a href="#">Table 2</a> ) | e.g. T1, D        |
| e) Rubber type (see ISO 1629)                         | e.g. EPDM         |
| f) Limited ozone resistance                           | O (if applicable) |
| g) Joint name   | e.g. Tradename    |

EXAMPLE SEAL/ISO 9631/OD 150/T1D/EPDM/Tradename.

## 10 Marking and labelling

Each seal, or parcel of seals where the marking of individual seals is not practicable, shall be marked clearly and durably as listed below, such that the sealing capability is not impaired:

- nominal size;
- manufacturer's identification;
- number of this document with the type of application, the ozone restriction (if applicable) and hardness class, e.g. ISO 9631/T1D/50;
- quarter and year of manufacture;
- abbreviation for rubber, e.g. EPDM — ethylene propylene diene terpolymer.

## Annex A (normative)

### Determination of splice strength

#### A.1 Principle

Seals spliced from pre-vulcanized rubber are elongated and examined.

#### A.2 Test pieces

Perform the test either on the seal itself or on a piece 200 mm long with the splice at the midpoint, i.e. such that there is a length of 100 mm on each side of the splice.

#### A.3 Procedure

Make two reference marks, equidistant from the splice and 50 mm apart, on the test piece and extend the test piece at a rate of  $(8,3 \pm 0,8)$  mm/s until the elongation between the reference marks is as specified in [Table A.1](#). Maintain this extension for 1 min and examine the seal or test piece under tension.

**Table A.1 — Required elongation between reference marks for splice strength**

Hardness class	Elongation %
Up to 70	100
80	75
90	50

## Annex B (normative)

### Determination of compression set in hot water at 110 °C for seals

#### B.1 Principles

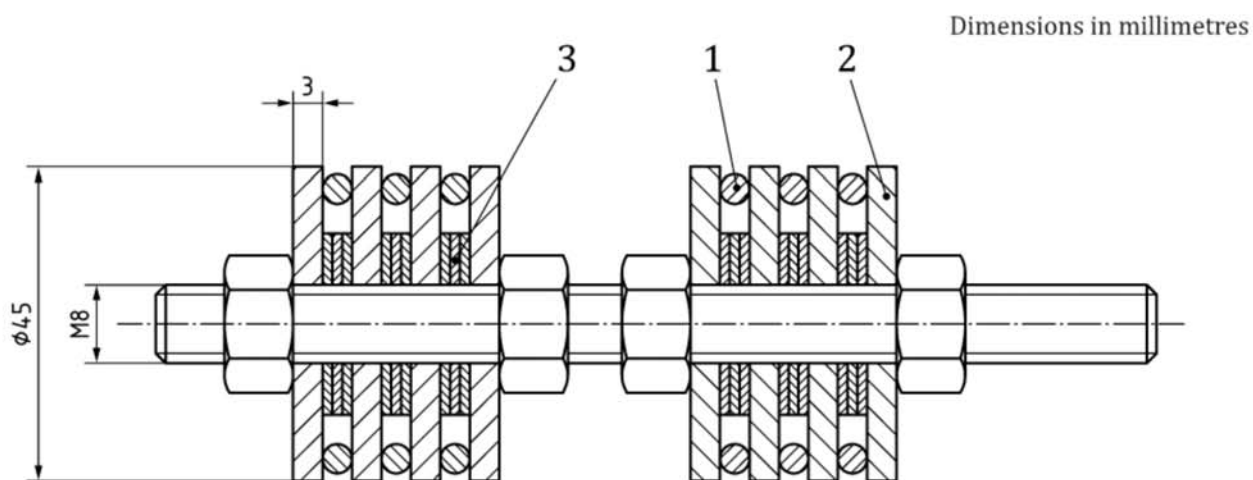
The compression set of the seal is measured after immersion in hot water.

#### B.2 Apparatus

**B.2.1 Compression jig** (see [Figure B.1](#)).

**B.2.2 Autoclave.**

The autoclave is made of steel quality X<sub>6</sub>CRNiMoTi17-12-2, X<sub>2</sub>CRNiMo17-12-2 or X<sub>5</sub>CRNiMo17-12-2 according to ISO 15510 and has a volume between 1 l and 5 l.



#### Key

- 1 seal under test
- 2 pressure plate (stainless steel)
- 3 spacer (stainless steel)

**Figure B.1 — Example compression jig for compression set in hot water**

#### B.3 Test piece

Use seals taken from production. At least three test pieces shall be tested. For the test, seals having a thickness of  $(3 \pm 0,3)$  mm are to be used. The diameter of the seals should be between 15 mm and 40 mm.



## B.4 Procedure

Place the seals in the jig and compress to give a compression of 25 %. Immerse the jig and seals for the given period (see [Tables 4, 5, 6, 7 or 8](#)) in distilled or deionized water in the autoclave at a temperature of  $(110 \pm 1,5) ^\circ\text{C}$ .

Immediately after taking the compression jig out of the autoclave, release the O-rings and cool for 30 min at standard laboratory temperature.

Measure the compression set in accordance with the method specified in ISO 815-1.

## Annex C (informative)

### Quality assurance

#### C.1 Type tests

All the tests necessary for the designation of rings should be carried out initially and whenever the manufacturing technique is changed. All tests having a test time of less than 3 months should be repeated at least once a year. All the tests should also be carried out whenever the elastomer formulation is changed. All of these should be carried out using test pieces cut from the finished ring or, if the shape of the ring does not permit test pieces to be produced, on laboratory samples of the same formulation, state of cure and method of preparation as the finished rings.

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

#### C.2 Product-control test

The following tests should be carried out using test pieces in accordance with [5.1](#), and the requirements in [Tables 3, 5, 6, 7](#) or [8](#) should be met for

- a) tensile strength,
- b) elongation at break,
- c) compression set, and
- d) hardness.

#### C.3 Sampling for product-control tests

Product-control tests should be carried out on batches of finished components, using sampling procedures in accordance with the appropriate standards like ISO 2859-1 (inspection level S-2 and AQL 2,5 %) or ISO 3951-1 (inspection level S-3 and AQL 2,5 %).

For ISO 2859-1 that means the amounts and limits as given in [Table C.1](#). These examples do not preclude the use by the manufacturer of more stringent combinations of inspection levels and AQL values from ISO 2859-1 or ISO 3951-1.

**Table C.1 — Sampling for FPC based on ISO 2859-1 (s-2, 2,5)**

Batch size	Number of samples	Acceptance number	Rejection number
Up to 35 000	5	0	1
More than 35 000	20	1	2

## **Annex D**

### **(informative)**

### **Guidance on storage of seals**

At all stages between manufacture and use, the seals should be stored in accordance with the recommendations given in ISO 2230.

The following points should be noted:

- a) The storage temperature should be below 25 °C and preferably below 15 °C.
- b) The seals should be protected from light, in particular strong sunlight and artificial light with a high ultraviolet content.
- c) The seals should not be stored in a room with any equipment capable of generating ozone, e.g. mercury vapour lamps or high-voltage electrical equipment which can give rise to electrical sparks or silent electrical discharges.
- d) The seals should be stored in a relaxed condition free from tension, compression or other deformation. For instance, they should not be suspended from any part of the circumference.
- e) The seals should be maintained in a clean condition.

## Bibliography

- [1] ISO 2230, *Rubber products — Guidelines for storage*
- [2] ISO 2285:2013, *Rubber, vulcanized or thermoplastic — Determination of tension set under constant elongation, and of tension set, elongation and creep under constant tensile load*
- [3] ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*
- [4] ISO 3951-1, *Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*
- [5] ISO 7743, *Rubber, vulcanized or thermoplastic — Determination of compression stress-strain properties*
- [6] ISO 9001, *Quality management systems — Requirements*
- [7] EN 253, *District heating pipes — Preinsulated bonded pipe systems for directly buried hot water networks — Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene*





