INTERNATIONAL STANDARD

ISO 4633

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Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials

Joints étanches en caoutchouc — Garnitures de joints de canalisations d'adduction et d'évacuation d'eau (égouts inclus) — Spécification des matériaux

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Contents

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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.

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 4633 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Miscellaneous products*.

This second edition cancels and replaces the first edition (ISO 4633:1983), which has been technically revised.

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

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Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials

1 Scope

This International Standard specifies requirements for materials used in vulcanized rubber seals for

a) cold drinking-water supplies (up to 50 °C);

b) drainage, sewerage and rainwater systems (continuous flow up to 45 °C and intermittent flow up to 95 °C).

The different designations of seals specified are defined according to their type, application and requirements (see table 3).

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, clay, fibre cement, concrete, reinforced concrete, plastics and glass-reinforced plastics.

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

Joint seals made with an enclosed void as part of their design are included in the scope of this International Standard.

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 37:1994, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties.*

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 188:1982, *Rubber, vulcanized — Accelerated ageing or heat-resistance tests.*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures.*

ISO 1431-1:1989, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static strain test.*

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

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 2285:— [1], *Rubber, vulcanized or thermoplastic — Determination of tension set at normal and high temperatures.*

1) To be published. (Revision of ISO 2285:1988)

ISO 3302:1990, *Rubber — Dimensional tolerances for use with products.*

ISO 3384:1991, *Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression at ambient and at elevated temperatures.*

ISO 3387:1994, *Rubbers — Determination of crystallization effects by hardness measurements.*

ISO 4661-1:1993, *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 Classification

Six classes of materials for pipe joint seals are specified in table 2 and three classes of materials in table 3.

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

4 Requirements

4.1 Requirements for materials

4.1.1 General

The materials shall be free of any substances which may have a deleterious effect on the fluid being conveyed, 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 4.1.2.

4.1.2 Effect on water quality

For cold-water applications, the materials shall not impair the quality of the water under the conditions of use. The materials shall comply with the national requirements in the country of use.

4.1.3 Microbiological deterioration

The materials shall be resistant to microbiological deterioration if the application so requires. The test methods and the requirements shall be as specified in national standards.

4.2 Requirements for finished seals

4.2.1 Dimensional tolerances

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

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;

— 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, could be considered as defects. This shall be agreed between the interested parties: the acceptance criteria 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 referred to in ISO 9691:1992 can be determined in accordance with ISO 7743[4] (see annex E). The acceptable limiting values of the compressive force shall be agreed between the interested parties: they depend upon the seal type or design.

4.2.3 Hardness

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

Table 1 — Hardness classification

Hardness class	40	50	60	70	80	90
Range of hardness, IRHD	36 to 45	46 to 55	56 to 65	66 to 75	76 to 85	86 to 95

Table 2 — Physical-property requirements for materials used in cold-water supply and drainage, sewerage and rainwater systems

Types WA, WC and WG (see table 3)				**Requirements for hardness classes**					
Property	**Unit**	**Test method**	**Subclause in this International Standard**	**40**	**50**	**60**	**70**	**80**	**90**
Permissible tolerance on nominal hardness	IRHD	ISO 48	4.2.3	±5	±5	±5	±5	±5	±5
Tensile strength, min.	MPa	ISO 37	4.2.4	9	9	9	9	9	9
Elongation at break, min.	%	ISO 37	4.2.4	400	375	300	200	125	100
Compression set, max.									
72 h at 23 °C	%	ISO 815	4.2.5.2	12	12	12	15	15	15
24 h at 70 °C	%	ISO 815	4.2.5.2	20	20	20	20	20	20
72 h at –10 °C	%	ISO 815	4.2.5.3	40	40	50	50	60	60
Ageing, 7 days at 70 °C		ISO 188	4.2.6						
Hardness change, max./min.	IRHD	ISO 48		+8/–5	+8/–5	+8/–5	+8/–5	+8/–5	+8/–5
Tensile-strength change, max.	%	ISO 37		–20	–20	–20	–20	–20	–20
Elongation change, max./min.	%	ISO 37		+10/–30	+10/–30	+10/–30	+10/–30	+10/–40	+10/–40
Stress relaxation, max.		ISO 3384	4.2.7						
7 days at 23 °C	%			13	14	15	16	17	18
100 days at 23 °C	%			19	20	22	23	25	26
Stress relaxation per logarithmic decade, max.	%			5,1	5,5	5,9	6,3	6,7	7,1
Volume change in water, max./min.									
7 days at 70 °C	%	ISO 1817	4.2.8	+8/–1	+8/–1	+8/–1	+8/–1	+8/–1	+8/–1
Ozone resistance		ISO 1431-1	4.2.9	No cracking when viewed without magnification					
Optional requirements									
Compression set, max.									
72 h at –25 °C	%	ISO 815	4.3.1	60	60	60	70	70	70
Hardness change, max.									
168 h at –25 °C	IRHD	ISO 3387	4.3.1	+18	+18	+18	—	—	—
Volume change in oil									
72 h at 70 °C		ISO 1817	4.3.2						
Oil No. 1, max./min.	%			±10	±10	±10	±10	±10	±10
Oil No. 3, max.	%			±50	±50	±50	±50	±50	±50

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

For the same seal, or along the greatest length of an extruded profile cut to make the seal, the difference between the minimum and maximum hardness shall not be more than 5 IRHD. Each value shall be within the specified tolerances.

4.2.4 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 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.

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 test piece, the compression set shall comply with the requirements given in table 2.

Where the cross-section is too small to obtain compression buttons from the product, as an alternative to moulding buttons the tension set of the product may be determined, using the method specified in ISO 2285 with a strain of 50 % and applying the same test conditions (except strain) and requirements as for compression set.

4.2.5.3 Low-temperature compression set at −10 °C

When determined by the method specified in ISO 815, at −10 °C, using the small test piece and the 30 min ± 3 min recovery measurement, the low-temperature compression set shall comply with the requirements given in table 2.

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, 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.

4.2.7 Stress relaxation in compression

The stress relaxation shall be determined by method A of ISO 3384:1991, using the small cylindrical test piece after carrying out 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. The 7-day and 100-day requirements in table 2 are those derived from this straight line.

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

joint seals for cold-water supplies:	7 days at 23 °C;
drainage, sewerage and rainwater systems:	100 days at 23 °C.

The 100-day test shall be considered as a type approval test. The requirement in respect of stress relaxation per logarithmic decade shall also be regarded as a type approval requirement.

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.

Where the cross-section is too small to obtain compression buttons from the product, as an alternative to moulding test pieces the stress relaxation in tension of the product may be determined, using the method specified in annex A with the same requirements as for stress relaxation in compression.

4.2.8 Volume change in water

When determined by the method specified in ISO 1817 after 7 days immersion in distilled or deionised water at 70 °C, the change in volume shall comply with the requirements given in table 2.

4.2.9 Ozone resistance

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

ozone concentration	50 pphm ± 5 pphm
temperature	40 °C ± 2 °C
pre-tension time	(72^{0}_{-2}) h
exposure time	(48^{0}_{-2}) h
elongation	
36 IRHD to 75 IRHD	(20 ± 2) %
76 IRHD to 85 IRHD	(15 ± 2) %
86 IRHD to 95 IRHD	(10 ± 1) %
relative humidity	(55 ± 10) %

the ozone resistance of vulcanized-rubber sealing elements which are attached to the pipe or fittings shall comply with the requirements given in table 2.

Rubber sealing elements which are protected and packaged separately up to the time of installation shall meet the same requirement but using an ozone concentration of 25 pphm ± 5 pphm.

4.2.10 Splices of prevulcanized profile ends

4.2.10.1 Spliced joints

These shall be vulcanized.

4.2.10.2 Strength of spliced joints

When tested by the method specified in annex B, there shall be no visible separation in the cross-sectional area of the splice when viewed without magnification.

4.3 Optional requirements

4.3.1 Low-temperature performance at –25 °C

When determined by the method specified in ISO 815, at –25 °C, the compression set shall comply with the requirements given in table 2.

When determined by the method specified in ISO 3387, the hardness change at –25 °C shall comply with the requirements given in table 2.

4.3.2 Volume change in oil

The resistance to oil shall be determined in accordance with ISO 1817. The volume change of test pieces (see subclause 8.2.2 of ISO 1817:1985) shall be determined after 72 h immersion in standard oils No. 1 and No. 3 (see clause A.2 of ISO 1817:1985) at a temperature of 70 °C.

The volume change in oil shall comply with the requirements in table 2.

5 Testing

5.1 Preparation of test pieces

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, 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.

5.2 Test temperature

Unless otherwise specified, tests shall be carried out at 23 °C ± 2 °C.

6 Quality assurance

Quality assurance testing is not an integral part of this International Standard, but guidance may be obtained from annex C, which recommends appropriate test frequencies, product control tests and sampling techniques.

Quality assurance shall be in accordance with ISO 9002[5] (see annex E).

7 Storage

See annex D.

8 Designation

Elastomeric seals for pipelines are designated according to their intended application as described in

table 3. The following information shall be used for a full designation of the seals:

a)	Description	e.g. "O" ring
b)	ISO Standard number	i.e. ISO 4633
c)	Nominal size	e.g. DN 150
d)	Type of application	e.g. WA (see table 3)
e)	Rubber type	e.g. SBR (see ISO 1629)
f)	Joint name	e.g. Manufacturer's tradename

EXAMPLE

"O" ring/ISO 4633/DN 150/WA/SBR/Tradename

9 Marking and labelling

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

a) The nominal size

b) The manufacturer's identification mark

c) The number of this International Standard, followed by the type of application and the hardness class, e.g. ISO 4633/WB/50

d) A third-party certification mark

e) The quarter and year of manufacture, e.g. 4Q 1996

f) The fact that the seal is low-temperature resistant (L), if appropriate, e.g. WAL

g) The fact that the seal is oil-resistant (O), if appropriate, e.g. WCO

h) The abbreviation for the type of rubber, e.g. SBR (see ISO 1629).

Table 3 — Designation of elastomeric joint seals by type, application and requirements

	Application	Requirements	Subclause
WA	Cold drinking-water supply (up to 50 °C)	Table 2 Effect on water quality	4.1.2
WC	Cold non-drinking-water supply, drainage, sewerage and rainwater pipes (continuous flow up to 45 °C and intermittent flow up to 95 °C)	Table 2	
WG	Cold non-drinking-water supply, drainage, sewerage and rainwater pipes (continuous flow up to 45 °C and intermittent flow up to 95 °C) with oil resistance	Table 2 Oil resistance	4.3.2

Annex A
(normative)

Determination of stress relaxation in tension

A.1 Principle

Measurements of force are taken, over a period of time, on a test piece kept at a fixed, extended length.

A.2 Apparatus

A.2.1 Stress apparatus (see figure A.1 for an example), consisting of two grips holding the test piece, without slipping, at a fixed, extended length.

The grips shall be arranged such that the force in the test piece can be measured, e.g. by fitting the stress apparatus to a tensile-testing machine.

A.2.2 Force-measuring system, accurate and stable to within 2 % of the force reading.

A.3 Test pieces

Prepare, from the finished ring, parallel-sided strips with dimensions as follows:

Thickness:	1 mm to 2 mm
Width:	4 mm to 10 mm
Length:	(80 ± 1) mm plus two times the length in the grips

Use three test pieces for each test.

A.4 Conditions of test

Carry out the test at the temperature given in 4.2.7.

A.5 Procedure

Mount the test piece in the grips in an unstrained condition. In less than 1 min, stretch the test piece to an elongation between 45 % and 55 %. Maintain this elongation throughout the test.

Measure the initial force 30 min ± 0,5 min after stretching the test piece.

Take further force measurements as specified in 4.2.7.

If a stress apparatus as shown in figure A.1 is used, fit the device to a tensile-testing machine. Take the force readings either by turning the knurled screws down or by using an additional strain to make the upper grip free from the supporting screws, in each case by not more than 0,2 mm. After measuring the tensional force, relieve to the initial strain, remove the stress apparatus from the tensile machine and store it to one side.

Dimensions in millimetres

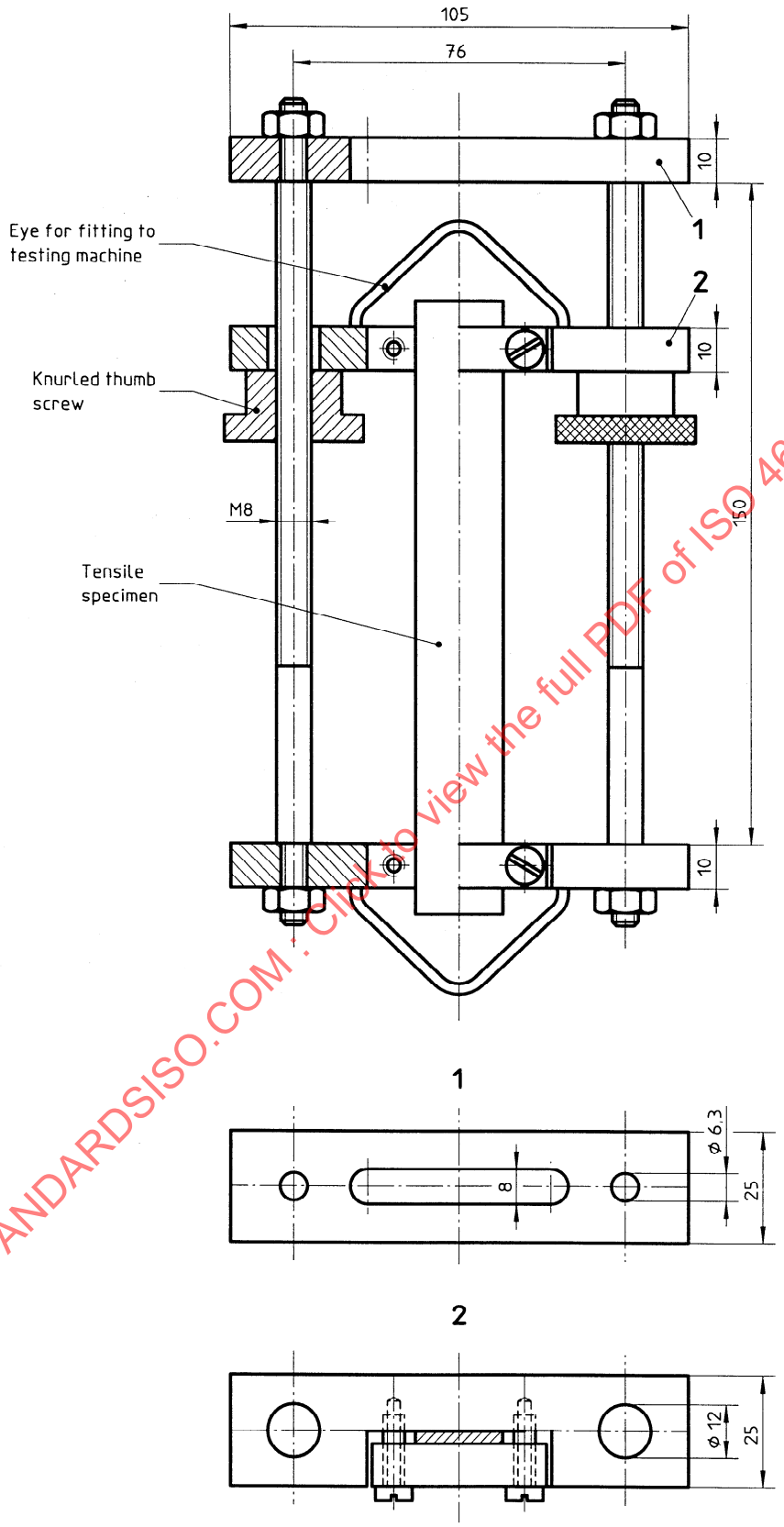

Figure A.1 — Example of an apparatus for determining stress relaxation in tension
(the dimensions given are for guidance only)

Annex B
(normative)

Determination of splice strength

B.1 Principle

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

B.2 Test pieces

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

B.3 Procedure

Make two reference marks, equidistant from the splice and 50 mm apart, on the seal or test piece, extend the seal or test piece at a rate of 8,3 mm/s ± 0,8 mm/s until the elongation between the reference marks is as specified in table B.1. Maintain this elongation for 1 min and examine the seal or test piece under tension.

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

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

Annex C
(informative)

Quality assurance

C.1 Type tests

All tests for the appropriate designation of rings should be carried out at least annually and whenever the manufacturing technique is changed. All tests should also be carried out whenever the elastomer formulation is changed. All of these should either be carried out using test pieces cut from the finished ring or, and only 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 prepared as in 5.1, and the requirements in table 2 should be met for

a) tensile strength;

b) elongation at break;

c) compression set;

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

a) ISO 2859-1[2] (see annex E), with a specified inspection level of for instance S-2 and an AQL of for instance 2,5 % for attributes;

or

b) ISO 3951[3] (see annex E), with a specified inspection level of for instance S-3 and an AQL of for instance 2,5 % for variables.

These examples of requirements 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.

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[1] (see annex E).

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 ultra-violet 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 may 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. They should not, for instance, be suspended from any part of the circumference.

e) The seals should be maintained in a clean condition.

Annex E
(informative)

Bibliography

[1] ISO 2230:1973, *Vulcanized rubber — Guide to storage.*

[2] ISO 2859-1:— [2], *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

[3] ISO 3951:1989, *Sampling procedures and charts for inspection by variable for percent nonconforming.*

[4] ISO 7743:1989, *Rubber, vulcanized or thermoplastic — Determination of compression stress-strain properties.*

[5] ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing.*

2) To be published. (Revision of ISO 2859-1:1989)