BRITISH STANDARD

BS EN
681-1 : 1996

Incorporating
Amendment No. 1

Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications

Part 1. Vulcanized rubber

The European Standard EN 681-1 : 1996, with the incorporation of its amendment A1 : 1998, has the status of a British Standard

ICS 23.040.80; 83.060

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PRI/70, Elastomeric seals for joints in pipework and pipelines, upon which the following bodies were represented:

British Gas plc
British Plastics Federation
British Precast Concrete Federation Ltd.
British Rubber Manufacturers' Association Ltd.
Chartered Institution of Water and Environmental Management
Clay Pipe Development Association Limited
Concrete Pipe Association
Ductile Iron Producers' Association
Fibre Cement Manufacturers' Association Limited
Malyasian Rubber Producers Research Association
RAPRA Technology Ltd.
Society of British Water Industries
Water Companies Association
Water Services Association of England and Wales

This British Standard, having been prepared under the direction of the Sector Committee for Materials and Chemicals, was published under the authority of the Standards Committee and comes into effect on 15 November 1996

Amendments issued since publication

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The following BSI references relate to the work on this standard:
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See national foreword.

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National foreword

This British Standard has been prepared by Technical Committee PRI/70 and is the English language version of EN 681-1 : 1996 *Elastomeric seals — Materials requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber* including amendment A1, published by the European Committee for Standardization (CEN).

EN 681-1 : 1996 was produced as a result of international discussions in which the United Kingdom took an active part.

EN 681-1 : 1996 has been approved by CEN member bodies under the weighted voting procedures introduced in 1988 to coincide with the introduction of 'New Approach' Directives from the Commission of the European Community.

To ensure that these products do not have any detrimental effects on the quality of water intended for human consumption, the materials of construction in contact with water will be tested in accordance with the method standards being developed by CEN/TC 64 concerned with effects of materials on water quality.

In the absence of these standards, the respective national standard, BS 6920 applies.

This standard supersedes requirements for vulcanized rubber seals types W, D, H and S, used in water and drainage applications as given in BS 2494 and these types will be withdrawn by amendment. Other Parts of BS EN 681 will be published in the future to supersede requirements for type T and type G seals in BS 2494.

Attention is drawn to paragraph 2 of the European foreword. It was decided by CEN/TC 208 that there would be a one year transition period during which vulcanized rubber seals may be produced to either BS 2494 or BS EN 681-1. Following the changeover period, BS 2494 will be amended to delete requirements for vulcanized rubber seals, i.e. by October 1997.

Cross-references

Publication referred to	Corresponding British Standard
ISO 37 : 1994	BS 903 *Physical testing of rubber* Part A2 : 1995 *Method for determination of tensile stress — strain properties*
ISO 48 : 1994	Part A26 : 1995 *Method for determination of hardness (hardness between 10 IRHD and 100 IRHD)*
ISO 188 : 1982	Part A19 : 1986 *Heat resistance and accelerated ageing tests*
ISO 471 : 1995	Part A35 : 1995 *Temperatures, humidities and times for conditioning and testing of test pieces*
ISO 815 : 1991	Part A6 : 1992 *Method for determination of compression set at ambient, elevated or low temperatures*
ISO 1431-1 : 1989	Part A43 : 1990 *Method for determination of resistance to ozone cracking (static strain test)*
ISO 1629 : 1987	BS 3502 *Symbols for plastics and rubber materials* Part 2 : 1991 *Schedule for symbols for rubbers* BS 903 *Physical testing of rubber*
ISO 1817 : 1985	Part A16 : 1987 *Determination of the effect of liquids*
ISO 2285 : 1988	Part A5 : 1993 *Method for determination of tension set at normal and high temperatures*
ISO 2859-1 : 1989	BS 6001 *Sampling procedures for inspection by attributes* Part 1 : 1991 *Specification for sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*
ISO 3302 : 1976	BS 3734 : 1978 *Specification for dimensional tolerances of solid moulded and extruded rubber products* BS 903 *Physical testing of rubber*
ISO 3384 : 1991	Part A42 : 1992 *Method for determination of stress relaxation in compression at ambient and elevated temperatures*

ISO 3387 : 1994	Part A63 : 1995 *Method for determination of crystallization effects by hardness measurements*
ISO 3951 : 1989	BS 6002 *Sampling procedures for inspection by variables* Part 1 : 1993 *Specification for single sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*
ISO 4661-1 : 1993	BS 903 *Physical testing of rubber* Part A36 : 1995 *Method for preparation of samples and test pieces*
ISO 9691 : 1992	BS 7677 : 1993 *Recommendations for classification of imperfections in pipe joint rings*
EN ISO 9002 : 1994	BS EN ISO 9002 : 1994 *Quality systems — Model for quality assurance in production and installation*
EN 45011 : 1989	BS 7511 : 1989 *General criteria for certification bodies operating product certification*
EN 45012 : 1989	BS 7512 : 1989 *General criteria for certification bodies operating quality systems certification*

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EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 681-1

April 1996

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May 1998

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Descriptors: Rubber products, vulcanized rubber, water pipelines, seal : stoppers, sealing rings, classifications, hardness, physical properties, tests, quality control, designation, marking

English version

Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber

(includes amendment A1 : 1998)

Garnitures d'étanchéité en caoutchouc — Spécification des matériaux pour garnitures d'étanchéité pour joints de canalisations utilisées dans le domaine de l'eau et de l'évacuation — Partie 1: Caoutchouc vulcanisé
(inclut l'amendement A1 : 1998)

Elastomer-Dichtungen — Werkstoff-Anforderungen für Rohrleitungs-Dichtungen für Anwendungen in der Wasserversorgung und Entwässerung — Teil 1: Vulkanisierter Gummi
(enthält Änderung A1 : 1998)

This European Standard was approved by CEN on 1996-04-07; amendment A1 was approved by CEN on 1998-05-28. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 208, Elastomeric seals for joints in pipework and pipelines, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 1996, and conflicting standards shall be withdrawn at the latest by October 1996.

This Part is based on ISO 4633 and ISO 9631, bringing these two sets of requirements (for cold and hot water respectively) under one specification. The major changes from ISO 4633 and ISO 9631 have been to incorporate requirements for effect on water quality and ozone resistance. The emphasis in respect of low temperature testing has moved away from hardness measurement to compression set, which is more discriminating.

A European Standard is to be prepared for material effects on water quality and when published it is intended that materials comply with the requirements of that standard.

A European Standard is also to be prepared for microbiological deterioration requirements and when published it is intended that materials comply with the requirements of that standard.

Part 2 has been prepared by CEN/TC 208 in response to requests from CEN/TC 155 for a material specification for thermoplastic elastomer seals for use in conjunction with non-pressure thermoplastic pipe systems.

Part 3 has been prepared in response to those sections of the pipeline industry which employ cellular seals of vulcanized rubber.

Part 4 has been prepared in response to those sections of the pipeline industry which employ cast polyurethane seals.

According to the CEN/CENELEC Internal Regulations, the national standards organization of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Foreword to amendment A1

This Amendment EN 681-1 : 1996/A1 : 1998 to the EN 681-1 : 1996 has been prepared by Technical Committee CEN/TC 208, Elastomeric seals for joints in pipework and pipelines, the secretariat of which is held by BSI.

This Amendment to the European Standard EN 681-1 : 1996 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 1998, and conflicting national standards shall be withdrawn at the latest by December 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

0 Introduction

The product (in accordance with this standard) which is in permanent or temporary contact with water, intended for human consumption, does not adversely affect the quality of the drinking water and does not contravene the EC Directives and EFTA Regulations on the quality of drinking water.

1 Scope

This standard specifies requirements for materials used in vulcanized rubber seals for:

1) cold potable water supply (up to 50 °C);

2) hot potable and non-potable water supply (up to 110 °C);

3) 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 4).

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 standard should be used where appropriate with product standards which specify performance requirements for joints.

This 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 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 European Standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to 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 — Accelerated ageing or heat-resistance tests*
ISO 471	*Rubber — Times, temperatures, and humidities for conditioning and testing*
ISO 815	*Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures*
ISO 816	*Rubber, vulcanized — Determination of tear strength of small test pieces (Delft test pieces)*
ISO 1431-1	*Rubber, vulcanized or thermoplastic — Resistance to ozone cracking Part 1: Static strain test*
ISO 1629	*Rubber and latices — Nomenclature*
ISO 1817	*Rubber, vulcanized — Determination of the effect of liquids*
ISO 2285	*Rubber, vulcanized or thermoplastic — Determination of tension set at normal and high temperatures*
ISO 2859-1	*Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*
ISO 3302	*Rubber — Dimensional tolerances for use with products*
ISO 3384	*Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression at ambient and at elevated temperatures*
ISO 3387	*Rubbers — Determination of crystallization effects by hardness measurements*
ISO 3951	*Sampling procedures and charts for inspection by variables for percent nonconforming*
ISO 4661-1	*Rubber, vulcanized or thermoplastic — Preparation of samples and test pieces — Part 1: Physical tests*

ISO 9691 : 1992	*Rubber — Recommendations for the worksmanship of pipe joint rings — Description and classification of imperfections*
EN ISO 9002	*Quality systems — Model for quality assurance in production and installation*
EN 45011	*General criteria for certification bodies operating product certification*
EN 45012	*General criteria for certification bodies operating quality system certification*

3 Classification

Six classes of material for pipe joint seals are specified in table 2, and 5 classes of materials in table 3.

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

4 Requirements

4.1 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 seal, or on the pipe or fitting. Elastomeric components of composite seals not exposed to the contents of the pipeline are not required to meet clause **4.1.2**.

4.1.2 *Effect on water quality*

For cold and hot potable 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.

4.2 Finished seal requirements

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 according to ISO 9691 : 1992, as follows:

– surface imperfections in zones involved in the sealing function as described in clause **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 clause **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 clause **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 seals' type or design respectively.

NOTE.2. Internal imperfections as described in clause **4.2** of ISO 9691 : 1992 could be considered as defects. The compressive force can be determined according to ISO 7743[1)]. The acceptable limiting values of the compressive force should be agreed between the interested parties; they depend upon the seals' type or design respectively.

4.2.3 *Hardness*

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

NOTE. 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 values shall not be more than 5 IRHD. Each value shall be within the specified tolerances.

Table 1. Hardness classification

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

[1)] ISO 7743 *Rubber, vulcanized or thermoplastic — Determination of compression stress-strain properties*

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 types 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 tables 2 and 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, 70 °C and 125 °C*

When determined by the method specified in ISO 815, at 23 °C, 70 °C and 125 °C, using the small type B test piece, the compression set shall comply with the requirements given in tables 2 and 3.

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 strain 50 % and shall comply with 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 type B test piece and the (30 ± 3) min recovery measurement, the compression set of seals used in cold water supply, drainage and sewerage applications shall comply with the requirements given in table 2.

4.2.6 *Accelerated ageing in air*

Test pieces prepared for the determination of hardness according to **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 the following temperatures and times:

– joint seals for cold water supply, drainage and sewerage, 7 days at 70 °C.

– joint seals for continuous hot water supply, 7 days at 125 °C.

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

4.2.7 *Stress relaxation in compression*

The stress relaxation shall be determined by method A of ISO 3384 using the small cylindrical test piece after applying mechanical and thermal conditioning. Measurements shall be taken after 3 h, 1, 3, 7 days for the 7 day test and after 3 h, 1, 3, 7, 30, 100 days for the 100 days 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 days requirements in tables 2 and 3 are those derived from these straight lines. For continuous measurement using apparatus as described in the first paragraph of **5.2** of ISO 3384 : 1991, the 7 days and 100 days requirements in tables 2 and 3 are those derived from the measurements at 7 days and 100 days.

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

Joint seals for cold water supply, drainage, sewerage and rainwater systems	7 days at 23 °C ± 2°C and 100 days at 23 °C ± 2°C
Joint seals for hot water supply	7 days at 23 °C ± 2°C and 7 days at 125 °C ± 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 days 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.

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.

For seals manufactured from isoprene–isobutylene copolymers see **4.2.11** for an alternative test.

4.2.8 *Volume change in water*

When determined by the method specified in ISO 1817 after 7 days immersion in distilled or deionized water at the temperatures specified below:

Joint seals for cold water supply, drainage, sewerage and rainwater systems	70 °C
Joint seals for hot water supply	95 °C

The change in volume shall comply with the requirements given in tables 2 and 3. For seals manufactured from isoprene–isobutylene copolymers see **4.2.1.1** for an alternative test.

4.2.9 *Ozone resistance*

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

Ozone concentration		(50 ± 5) p.p.h.m
Temperature		(40 ± 2) °C
Pretension time		$(72^{\ 0}_{-2})$ h
Exposure time		$(48^{\ 0}_{-2})$ h
Elongation	36 to 75 IRHD	(20 ± 2) %
	76 to 85 IRHD	(15 ± 2) %
	86 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 tables 2 and 3.

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 ± 5) p.p.h.m.

4.2.10 *Tear strength for joint seals for hot water supply*

When determined by the method specified in ISO 816 the tear strength shall comply with the requirements given in table 3.

For seals manufactured from isoprene–isobutylene copolymers see **4.2.11** for an alternative test.

4.2.11 *Compression set in water for joint seals for hot water supply*

The materials shall comply with the requirements given in table 3.

For seals manufactured from isoprene–isobutylene copolymers only, as an alternative to requirements in **4.2.7**, **4.2.8** and **4.2.10** the compression set in water may be determined using the method specified in annex B.

4.2.12 *Splices of prevulcanized profile ends*

4.2.12.1 Spliced joints shall be vulcanized.

4.2.12.2 *Strength of spliced joints*

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

4.3 Optional requirements for joint seals for cold water supply, drainage and sewerage

4.3.1 General

If seals meet the optional additional requirements as specified in **4.3.2** and **4.3.3** they shall be appropriately marked (see **10**).

4.3.2 *Low temperature performance at −25 °C*

When determined by the method specified in ISO 815 at −25 ° C, using the small type B test piece and the (30 ± 3) min recovery measurement, the compression set of the seals 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.

4.3.3 *Volume change in oil*

The resistance to oil shall be determined according to ISO 1817. The volume change of test pieces shall be determined after 72 h immersion in standard oils No 1 and No 3 at a temperature of 70 °C.

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

NOTE. If No. 3 oil is no longer available it is recommended that IRM903 is used.

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 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 pieces 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 ± 2) ° C, in accordance with ISO 471.

NOTE. Two standard laboratory temperatures are given in this standard.

6 Quality

6.1 General

The manufacturer shall establish and maintain an effective documented quality supervision system comprising internal quality control and third party assessment, so as to achieve compliance with product standards.

6.2 Internal control

Internal quality control shall comprise continuous inspection carried out by the manufacturer as part of an approved third party assessment to ensure compliance with the requirements of this product standard under a quality system complying with EN ISO 9000 series or equivalent.

6.3 Inspection and audits by third party assessment bodies

The third party inspection shall be carried out at least twice a year without previous notice.

The assessment bodies shall visit the manufacturer's works to inspect testing and to check records. In addition the third party assessment body shall carry out audits according to the requirements of this product standard and for each third party inspection any tests in tables 2 and 3 except those which last more than 28 days shall be carried out at the discretion of the third party assessment body.

The third party assessment body shall comply with the requirements of EN 45011 and EN 45012, or equivalent.

7 Factory product control tests

7.1 Sampling

The product control tests shall be carried out on lots of finished components using sampling procedures in accordance with either:

a) ISO 2859-1 with a specified inspection level of S2 and an AQL of 2.5 % for attributes; or

b) ISO 3951 with a specified inspection level of S3 and an AQL of 2.5 % for variables.

These 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.

7.2 Routine tests

Tests in accordance with **4.2.1** and **4.2.2** shall be carried out. The following tests shall be carried out according to the methods listed in tables 2 and 3 using test pieces in accordance with **5.1**.

a) hardness

b) tensile strength

c) elongation at break

d) compression set for 24 h at 70 °C or at 125 °C (where appropriate)

e) splice strength where appropriate.

7.3 Type tests

All tests except those having a duration in excess of 28 days shall be carried out at least annually and whenever the manufacturing technique is changed significantly. Those tests having a duration in excess of 28 days shall be repeated at five year intervals. All tests, without exception, shall also be carried out initially and whenever the elastomer formulation is changed significantly.

8 Storage

See annex D.

9 Designation

Elastomeric seals for pipelines are designated according to their intended application as described in table 4. The following information shall be used for a full designation of the seals:

a) Description e.g. 'O' ring

b) European Standard No. i.e. EN 681-1

c) Nominal size e.g. DN 150

d) Type of application e.g. WA (see table 4)

e) Rubber type e.g. SBR (see ISO 1629)

f) Joint name e.g. 'Tradename'.

Example

'O' ring/EN 681-1/DN 150/WA/SBR/Tradename

10 Marking and labelling

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

a) Nominal size

b) Manufacturer's identification

c) The number of this standard with the type of application and hardness class as a suffix, e.g. EN 681-1/ WB/50

d) Third party certification mark

e) The quarter and year of manufacture

f) Low temperature resistance (L) if appropriate e.g. WAL

g) Oil resistant (O) if approprate e.g. WCO

h) The abbreviation for the rubber, e.g. SBR

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

Types WA, WC and WG				Requirements for hardness classes					
Property	**Unit**	**Test method**	**Clause**	**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.	IRHD	ISO 48		+8/−5	+8/−5	+8/−5	+8/−5	+8/−5	+5/−5
Tensile strength change, max.	%	ISO 37		−20	−20	−20	−20	−20	−20
Elongation change, max.	%	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
Volume change in water, 7 days at 70 °C, max.	%	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	**4.3.2**	60	60	60	70	70	70
Hardness change, max. 168 h at −25 °C	IRHD	ISO 3387	**4.3.2**	+18	+18	+18	—	—	—
Volume change in oil, max. 72 h at 70 °C		ISO 1817	**4.3.3**						
Oil No. 1	%			±10	±10	±10	±10	±10	±10
Oil No. 3	%			+50/−5	+50/−5	+50/−5	+50/−5	+50/−5	+50/−5

Table 3. Physical property requirements for materials used in continuous hot water supply up to 110 °C

Types WB, WD, WE, WF				**Requirements for hardness classes**				
Property	**Unit**	**Test method**	**Clause**	**50**	**60**	**70**	**80**	**90**
Permissible tolerance on nominal hardness	IRHD	ISO 48	**4.2.3**	± 5	± 5	± 5	± 5	± 5
Tensile strength, min.	MPa	ISO 37	**4.2.4**	9	9	9	9	9
Elongation at break, min.	%	ISO 37	**4.2.4**	250	200	200	100	100
Compression set, max.								
72 h at 23 °C	%	ISO 815	**4.2.5.2**	15	15	15	15	15
24 h at 125 °C	%	ISO 815	**4.2.5.2**	20	20	20	20	20
Ageing, 7 days at 125 °C		ISO 188	**4.2.6**					
Hardness change, max.	IRHD	ISO 48		+8/−5	+8/−5	+8/−5	+8/−5	+5/−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	**4.2.7**					
7 days at 23 °C	%			15	15	15	18	18
7 days at 125 °C[1)]	%			30	30	30	30	30
Volume change in water, max.[1)] 7 days at 95 ° C	%	ISO 1817	**4.2.8**	+8/−1	+8/−1	+8/−1	+8/−1	+8/−1
Ozone resistance	—	ISO 1431-1	**4.2.9**	No cracking when viewed without magnification				
Tear strength, min. 1)	N	ISO 816	**4.2.10**	20	20	20	20	20
Compression set in water, max.[1)2)]		Annex B						
70 days at 110 °C	%		**4.2.11**	30	30	30	30	30

[1)] See clause **4.2.11**.

[2)] This requirement only applies to isoprene–isobutylene copolymers.

Table 4. Designation of elastomeric joint seals by type, application and requirements			
Type	**Application**	**Requirements**	**Clause nos.**
WA	Cold potable water supply (up to 50 °C)	Table 2 Effect on water quality	 **4.1.2**
WB	Hot potable water (continuous supply up to 110 °C)	Table 3 Effect on water quality	 **4.1.2**
WC	Cold non-potable water supply, drainage, sewerage and rainwater pipes (continuous flow up to 45 °C and intermittent flow up to 95 °C)	Table 2	**4.1.3**
WD	Hot non-potable water (continuous supply up to 110 °C)	Table 3	**4.1.3**
WE	Hot potable water (continuous supply up to 110 °C) seals manufactured from isoprene–isobutylene copolymer	Table 3 Effect on water quality Compression set in hot water	 **4.1.2** **4.2.11**
WF	Hot non-potable water (continuous supply up to 110 °C) seals manufactured from isoprene–isobutylene copolymer	Table 3 Compression set in hot water	 **4.2.11**
WG	Cold non-potable 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, taken over a period of time, on a test piece at a fixed extended length.

A.2 Apparatus

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

Grips 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

Parallel sided strips prepared from the finished seal with dimensions as follows:

Thickness: 1 mm to 2 mm

Width: 4 mm to 10 mm

Length: (80 ± 1) mm plus two times the gripping length

Three test pieces shall be used for each test.

A.4 Test conditions

Test temperature as given in **4.2.7**.

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.

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, *Fo*, (30 ± 0.5) min after stretching the test piece.

Take further force measurements, *Fe*, as specified in **4.2.7**.

NOTE. If a stress apparatus according to 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 both by not more than 0.2 mm. After measuring the tension force, relieve to the initial strain, remove the stress apparatus from the tensile machine and store it aside.

Annex B (normative)
Determination of compression set in hot water at 110 °C

B.1 Principle

Measurement of compression set of seal rings after immersion in hot water.

B.2 Apparatus

B.2.1 *Compression jig* (see figure B.1).

B.2.2 ***Autoclave***

B.3 Test pieces

Consist of 'O' rings taken from production. At least 3 test pieces shall be tested.

B.4 Procedure

Place the 'O' rings and compress in the jig. The 'O' ring deformation between the steel plates of the compression jig shall be 25 %. Immerse the jig and 'O' rings for 70 days in distilled or deionized water at a termperature of (110 ± 1,5) °C (autoclave).

Immediately after taking the compression jig out of the autoclave, discharge the 'O' rings and cool for 30 min in ambient conditions.

Carry out the measurement of compression set in accordance with the method specified in ISO 815.

Annex C (normative)
Determination of splice strength

C.1 Principle

Seals spliced from prevulcanized rubber are elongated and examined.

C.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.

C.3 Procedure

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

Table 5. Required elongation between reference marks for splice strength

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

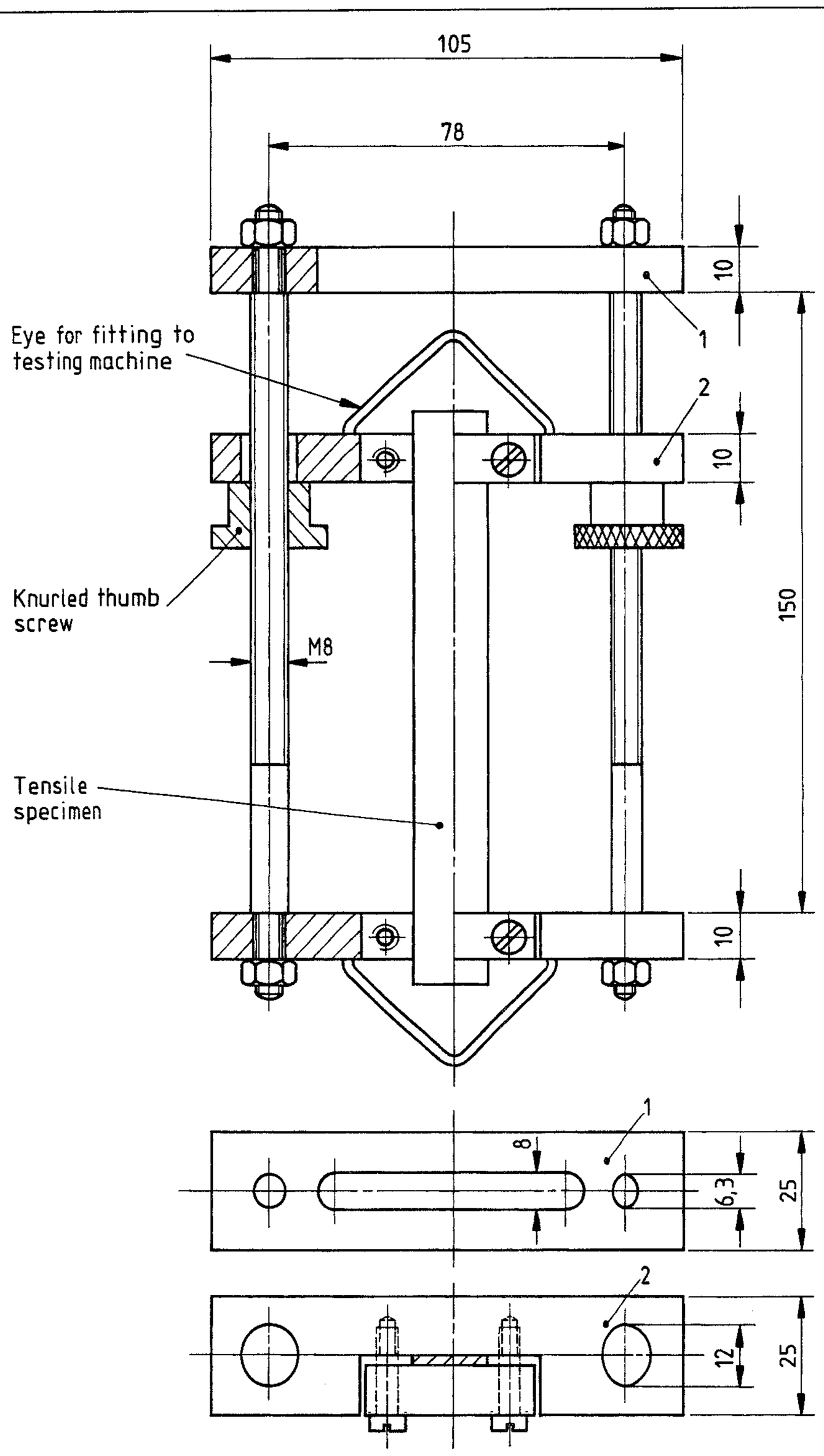

Figure A.1 Apparatus for testing the stress relaxation in tension (the dimensions (in mm) are given for guidance only)