BRITISH STANDARD

BS EN
549 : 1995

Specification for

Rubber materials for seals and diaphragms for gas appliances and gas equipment

The European Standard EN 549 : 1994 has the status of a British Standard

STANDARDS

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee GSE/22, Safety and controls for gas burners and appliances, upon which the following bodies were represented:

Association of Control Manufacturers (TACMA (BEAMA Ltd.))
British Combustion Equipment Manufacturers' Association
British Gas plc
Department of Trade and Industry (Consumer Safety Unit, C A Division)
Electricity Association
L P Gas Association
Society of British Gas Industries

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National foreword

This British Standard has been prepared by Technical Committee GSE/22 and is the English language version of EN 549 : 1994, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*, published by the European Committee for Standardization (CEN).

It supersedes BS 6505 which is withdrawn.

EN 549 was produced as a result of international discussion in which the UK took an active part.

Cross-references

Publication referred to	Corresponding British Standard
	BS 903 *Physical testing of rubber*
ISO 48	Part A26. *Determination of hardness*
ISO 188	Part A19. *Heat resistance and accelerated ageing tests*
ISO 247	BS 7164 *Chemical tests for raw and vulcanized rubber* Part 5. *Methods for determination of ash content* BS 903 *Physical testing of rubber*
ISO 471	Part A35. *Temperatures, humidities and times for conditioning and testing of test pieces*
ISO 815	Part A6. *Method for determination of compression set at ambient, elevated or low temperatures*
ISO 1400	Part A26. *Determination of hardness*
ISO 1407	BS 1673 *Methods of test for raw rubber and unvulcanized compounded rubber* Part 2. *Chemical analysis of raw natural rubber* BS 903 *Physical testing of rubber*
ISO 1431-1	Part A43. *Method for determination of resistance to ozone cracking (static strain test)*
ISO 1817 : 1985	Part A16. 1987 *Determination of the effect on liquids* BS 903 *Physical testing of rubber*
ISO 4648	Part A38. *Methods for the determination of dimensions of test pieces and products for test purposes*
ISO 4650	BS 4181 *Identification of rubbers by infra-red spectrometry* Part 1. *Method for identification of hydrocarbon, chloroprene, nitrile and chlorosulphonated polyethylene rubbers*

Compliance with a British Standard does not of itself confer immunity from legal obligations.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 549

November 1994

ICS 21.140; 83.060

Descriptors: Household appliances, gas appliances, adjusting systems, membranes, seals: stoppers, rubber products, classifications, specifications, mechanical properties, tests

English version

Rubber materials for seals and diaphragms for gas appliances and gas equipment

Matériaux à base de caoutchouc pour joints et membranes destinés aux appareils à gaz et appareillages pour le gaz

Elastomer-Werkstoffe für Dichtungen und Membranen in Gasgeräten und Gasanlagen

This European Standard was approved by CEN on 1994-11-08. 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

Ref. No. EN 549 : 1994 E

Foreword

This European Standard was prepared by the Technical Committee CEN/TC 108, Sealing materials and lubricants for gas appliances and gas equipment, of which the secretariat is held by NNI.

This European Standard is a compilation of EN 278 : 1991, EN 279 : 1991 and EN 291 : 1992.

Annex A is normative and contains verification of components by physical and chemical testing, annex B is also normative and contains verification of components by infra-red spectrometric method.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EC Directive(s).

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 December 1995, and conflicting national standards shall be withdrawn at the latest by December 1995.

In accordance with the CEN/CENELEC Internal Regulations, 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 United Kingdom.

Contents

Introduction

This European Standard specifies the requirements for materials to be used for the manufacture of seals and diaphragms. It specifies for that purpose, tests to be carried out on standardized test pieces taken from sheets of material, since the small size of most components does not, in general, allow for the necessary standard samples to be prepared from them in order to undertake the complete range of tests.

It may be necessary to carry out supplementary tests on the component mounted in the gas appliance, or in equipment such as safety and control devices, to confirm the functional suitability of the component. Such tests should be performed under the most severe service conditions envisaged in the appropriate standards for the gas appliances and/or equipment.

1 Scope

This standard specifies requirements and associated test methods for vulcanized rubber materials used in gas appliances and equipment in contact with 1st, 2nd and 3rd family combustible gases. It also establishes a classification based on temperature range and hardness. This standard is applicable to materials from which are manufactured homogeneous seals and homogeneous or reinforced diaphragms.

The normal range of operating temperatures covered by this standard is 0 °C to +60 °C. Tests are also included for applications using diaphragms within the range −20 °C to +80 °C and seals within the range −20 °C to +150 °C. For temperatures outside these ranges the user should contact the manufacturer regarding the suitability of the rubber material.

This standard includes two normative annexes for the verification that a component (finished product) was produced from a previously type tested material complying with requirements of this standard as declared by the appliance or equipment manufacturer or supplier of the component.

This standard is not applicable to silicone rubber used either above 200 mbar nominal pressure or at temperatures below 0 °C with 3rd family gases as there is possibility of condensation. This standard is also not applicable to seals and diaphragms for devices in gas transmission systems nor in such equipment used in 1st and 2nd family gas distribution systems.

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 — Determination of tensile stress-strain properties*
ISO 48	*Vulcanized rubbers — Determination of hardness (Hardness between 30 and 85 IRHD)*
ISO 188	*Rubber vulcanized — Accelerated ageing or heat-resistance tests*
ISO 247	*Rubber — Determination of ash*
ISO 471	*Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces*
ISO 815	*Rubber, vulcanized or thermoplastic — Determination of compression set at ambient elevated or low temperatures*
ISO 1400	*Vulcanized rubbers of high hardness (85 to 100 IRHD) — Determination of hardness*
ISO 1407	*Rubber — Determination of solvent extract*
ISO 1431-1 : 1989	*Rubber vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static strain test*
ISO 1817 : 1985	*Rubber, vulcanized — Determination of the effect of liquids*
ISO 4648	*Rubber, vulcanized or thermoplastic — Determination of dimensions of test pieces and products for test purposes*
ISO 4650	*Rubber — Identification — Infra-red spectrometric method*

Table 1. Temperature classes											
											Values in degrees C
Class		A1	B1	C1	D1	E1	A2	B2	C2	D2	E2
Range of operating temperature	from	0	0	0	0	0	−20	−20	−20	−20	−20
	to	60	80	100	125	150	60	80	100	125	150

3 Definitions

For the purposes of this standard the following definitions apply.

3.1 component

Finished product manufactured from rubber material.

3.2 seal

A component used as an interface between parts of a gas appliance or parts of gas equipment to achieve gas tightness.

3.2.1 static seal

A component which ensures a seal between two parts of a gas appliance or parts of gas equipment which do not have relative movement ('O' rings, sheet gaskets, etc.).

3.2.2 dynamic seal

A component which ensures a seal between two parts of a gas appliance or parts of gas equipment which have relative movement (lip seals, valve pads and some 'O' rings).

3.3 diaphragm

A membrane of rubber material located in a fixture and serving as a flexible gas tight partition between two chambers.

3.4 reinforcement

Woven or unwoven material arranged in or on the rubber type material, thus reinforcing certain properties of such, for example the bursting strength of diaphragms.

4 Manufacturer's declared information

The manufacturer responsible for the production of material complying with this standard shall ensure that he declares the following information which shall be documented:

- a unique material reference;
- the nominal hardness;
- the maximum working temperature of the material;
- the minimum working temperature of the material;
- whether the material is resistant to ozone;
- for reinforced material, a full specification of the reinforcement, for example type of material, basic construction and decitex.

NOTE. It is recommended that diaphragms should be ozone resistant. Because of the potential interruption of any protective surface coating, such as waxes, by dynamic flexing such methods of protection against ozone attack shall not be used without additional protective additives.

5 Classification

Materials shall be classified according to temperature range and hardness as given in table 1 and table 2 respectively.

NOTE. Seals can be manufactured from materials of class A1 to E1 and A2 to E2, whilst diaphragms are prepared from class A1 to B1 and A2 to B2.

Table 2. Hardness classes			
			Values in IRHD
Class	H1	H2	H3
Nominal hardness range	< 45	45 to 60	> 60 to 90

EXAMPLE: The classification of a rubber material applicable over the temperature range of −20 °C to +80 °C with a declared nominal hardness of 70 IRHD would be B2/H3.

6 Requirements

6.1 General

Materials shall be free from porosity, inclusion, blisters and surface imperfections visible to the naked eye even after cutting.

6.2 Physical and chemical properties of rubber materials used for the manufacture of seals

When tested in accordance with the methods detailed in clause **7**, using standard test pieces, the material shall comply with the requirements given in table 3.

6.3 Physical and chemical properties of rubber material used for the manufacture of diaphragms

When tested in accordance with the methods detailed in clause **7**, using standard test pieces, the material shall be in accordance with the requirements given in table 4.

Table 3. Requirements for material used to manufacture seals

Property	Unit	Hardness class		
		H1	H2	H3
Hardness Tolerance on stated nominal hardness	IRHD	±5	±5	±5
Tensile strength	MPa	≥5	≥7	≥7
Elongation at break	%	≥125	≥125	≥125
Compression set				
— at high temperature [1]	%	≤40	≤40	≤40
— at low temperature 0 °C	%	≤40	≤40	≤40
— at low temperature −20 °C	%	≤50	≤50	≤50
Resistance to ageing				
— change in hardness, max.	IRHD	±10	±10	±10
— change in tensile strength, max.	%	−40	−40	−40
— change in elongation at break, max.	%	−40	−40	−40
Resistance to gas [2]				
— change in mass after immersion, max.	%	+10 − 5	+10 − 5	+10 − 5
— change in mass after drying, max.	%	+5 −8	+5 −8	+5 −8
Resistance to lubricants [3]				
— change in hardness, max.	IRHD	±10	±10	±10
— change in mass, max.	%	+15 −10	+15 −10	+15 −10
Resistance to ozone [4]		no cracks		

[1] The test piece shall not be damaged by adhering to the surface of the test apparatus.

[2] For silicone material there is no requirement for change in mass after immersion as swelling by some such materials may be substantial, the requirement for change in mass after drying, is ± 5 %.

[3] For silicone material the requirement for change in hardness and mass are ± 15 IRHD and $^{+10}_{-1}$% respectively.

[4] This requirement is only applicable if the material has been declared by the manufacturer to be ozone resistant.

Table 4. Requirements for material used to manufacture diaphragms

Property	Unit	Hardness class		
		H1	H2	H3
Hardness Tolerance on stated nominal hardness	IRHD	±5	±5	±5
Tensile strength	MPa	≥5	≥7	≥10
Elongation at break	%	≥500	≥300	≥200
Compression set [1]				
— at high temperature	%	≤35	≤25	≤25
— at low temperature 0 °C	%	≤40	≤40	≤40
— at low temperature −20 °C	%	≤50	≤50	≤50
Resistance to ageing				
— change in hardness, max.	IRHD	±8	±8	±8
— change in tensile strength, max.	%	−15	−15	−15
— change in elongation at break, max.	%	−25	−25	−25
Resistance to gas [2]				
— change in mass after immersion, max	%	±10	+10 − 5	+10 − 5
— change in mass after drying, max.	%	+ 5 −15	+ 5 −10	+5 −8
Resistance to lubricants				
— change in hardness, max.	IRHD	±10	±10	±10
— change in mass, max.	%	+15 −10	+15 −10	+15 −10
Resistance to ozone [3]		no cracks		

[1] The test piece shall not be damaged by adhering to the surface of the test apparatus.

[2] This requirement excludes the use of silicone material. In some applications it may be possible to leave the requirement for change in mass after immersion when care is taken that:

— there is no risk of formation of gas condensate in the application;

— the permeation rate is no problem in the application;

— the low tear resistance is compensated by reinforcement or construction.

[3] This requirement is only applicable if the material has been declared by the manufacturer to be ozone resistant.

7 Test methods

In addition to the conditions below reference should be made to table 5.

7.1 General

Test pieces shall be cut from a sheet of material of (2 ± 0,2) mm or (6,3 ± 0,3) mm thickness as specified in the method of test. Measurements of thickness shall be carried out as specified in ISO 4648.

The material shall be from the same compound formulation used to make the component, vulcanized under conditions which are comparable to those used in production.

7.2 Hardness

Five measurements shall be taken using the micro-hardness test method on three test samples of sheet material at a test temperature of (23 ± 2) °C; as follows:

a) if the declared nominal hardness is 85 IRHD or less, use ISO 48;

b) if the declared nominal hardness is greater than 85 IRHD use ISO 1400.

7.3 Tensile strength and elongation at break

Measurements are carried out on six dumb-bell test pieces, type 2, in accordance with the test method given in ISO 37 at a test temperature of (23 ± 2) °C.

7.4 Compression set

7.4.1 Three monoblock test piece discs of (13 ± 0,5) mm diameter and (6,3 ± 0,3) mm thickness shall be tested in accordance with the method given in ISO 815 and the following special conditions:

- compression: 25 % at (23 ± 2) °C;
- duration of test: (168^{0}_{-2}) h for seals, $(24^{0}_{-0,5})$ h for diaphragms;
- test temperature: see table 5.

7.4.2 Three monoblock test pieces discs of (13 ± 0,5) mm diameter and (6,3 ± 0,3) mm thickness of materials having a classification of A1, B1 ..... E1 shall be tested in accordance with ISO 815 using the following special conditions:

- compression: 25 % at (23 ± 2) °C;
- duration of test: (72^{0}_{-2}) h;
- test temperature: (0 ± 1) °C;
- recovery time: (30 ± 3) min.

7.4.3 Three monoblock test piece discs of (13 ± 0,5) mm diameter and (6,3 ± 0,3) mm thickness of materials having a classification of A2, B2 .....E2 shall be tested in accordance with ISO 815 using the following special conditions:

- compression: 25 % at (23 ± 2) °C;
- duration of test: (72^{0}_{-2}) h;
- test temperature: (−20 ± 1) °C;
- recovery time: (30 ± 3) min.

7.5 Resistance to ageing

Dumb-bell test pieces type 2 (six for both tensile strength and elongation at break and three for hardness testing) are tested in accordance with ISO 188 using a normal air oven under the following special conditions:

- duration of ageing: (168^{0}_{-2}) h;
- test temperature: see table 5.

NOTE. It is permissible for the hardness test to be carried out on the tensile strength test pieces.

7.6 Resistance to gas

Three test pieces of dimension 50 mm × 20 mm × 2 mm shall be tested in accordance with **8.2** of ISO 1817 : 1985 and the following special conditions:

- immerse for (72^{0}_{-2}) h at (23 ± 2) °C in *n*-pentane;

NOTE. 98 % minimum *n*-pentane by mass, estimated by gas chromatography.

- after removal from the liquid, wipe dry rapidly and weigh immediately;
- determine the new change in mass with reference to the initial mass of the sample;
- dry the test specimens for a period of (168^{0}_{-2}) in a normal air oven at (40 ± 2) °C;
- determine the new change in mass with reference to the initial mass of the sample.

Calculate the arithmetic mean values of the three results both after immersion and after drying.

7.7 Resistance to lubricants

Three test pieces of dimensions 50 mm × 20 mm × 2 mm shall be tested in accordance with **8.2** (gravimetric method) and **11.2** (hardness test) of ISO 1817 : 1985 and the following special conditions:

- immerse for $(168^{\ 0}_{-2})$ h in oil no. 2 at the test temperature given in table 5;
- determine the change in mass and the change in hardness with reference to that of the initial samples.

Calculate the arithmetic mean values of the results after immersion.

7.8 Resistance to ozone

Test pieces shall be tested in accordance with ISO 1431-1 : 1989 method A using:

- duration of test: $(24^{\ 0}_{-0,5})$ h;
- concentration of ozone: (50 ± 5) pphm by volume [1];
- test temperature: (30 ± 2) °C;
- relative humidity: < 65 %;
- elongation of test sample: (20 ± 2) %.

[1] pphm: parts per hundred millions

Table 5. Test method

Property	ISO	Test pieces		Test temperature °C	Duration of test h	Remarks
		Type	No.			
Hardness	48 or 1400	—	3	23 ± 2	—	—
Tensile strength and elongation at break	37	Dumb-bell Type 2	6	23 ± 2	—	—
Compression set						
— at high temperature	815	Monoblock small type	3	*Class* A1, A2 70 ± 1 B1, B2 100 ± 1 C1, C2 125 ± 1 D1, D2 150 ± 1 E1, E2 175 ± 1	168^{0}_{-2} $24^{0}_{-0,5}$	For seals For diaphragms
— at low temperature	815	Monoblock small type	3	A1 to E1 0 ± 1 or A2 to E2 −20 ± 1	72^{0}_{-2}	Final measurement after (30 ± 3) min at (0 ± 1) or (−20 ± 1)°C at the end of the exposure period
Resistance to ageing	188	—	—	*Class*	168^{0}_{-2}	Normal oven
— hardness	48 or 1400	—	3	A1, A2 70 ± 1		
— tensile strength and elongation at break	37	Dumb-bell Type 2	6	B1, B2 100 ± 1 C1, C2 125 ± 1 D1, D2 150 ± 1 E1, E2 175 ± 1		
Resistance to gas immersion in *n*-pentane	1817	(50 × 20 × 2) mm	3	23 ± 2	72^{0}_{-2}	Weigh and determine the change in mass. Use the arithmetic mean value, both after immersion and drying
— drying	—	—	—	40 ± 2	168^{0}_{-2}	
Resistance to lubricants — immersion in oil No. 2	1817 (**8.2** and **11.2**)	(50 × 20 × 2) mm	3	*Class* A1, A2 60 ± 1 B1, B2 80 ± 1 C1, C2 100 ± 1 D1, D2 100 ± 1 E1, E2 100 ± 1	168^{0}_{-2}	Determine the increase in mass and the change in hardness
Resistance to ozone	1431/1 Method A	—	3	30 ± 2	$24^{0}_{-0,5}$	Using an ozone concentration of (50 ± 5) pphm elongation (20 ± 2) % view with 7-fold magnification

Annex A (normative)

Verification of components by physical and chemical testing

A.1 Scope

This normative annex specifies the requirements and test methods to enable the verification and quality control to be undertaken between rubber components used in the production of gas appliances and equipment against the previous type-tested material complying with this standard, using similar physical and chemical test methods as those used for testing sheet material.

Since the dimensions and shape of the components differ from those of standard test pieces taken from sheet material as used for type testing of the rubber materials according to this standard, allowances have been made in the requirements specified for the components with respect to those specified for standard test pieces.

By conducting comparative tests on samples of similar size to that of the components taken from the corresponding sheet material it should be possible to reduce these allowances and achieve a higher degree of agreement.

A.2 Requirements

A.2.1 *General*

Components shall be free from porosity, inclusions, blisters and surface imperfections visible to the naked eye, even after cutting.

For reinforced diaphragms there shall be no sign of delamination upon receipt nor after testing in accordance with methods laid down in this annex.

A.2.2 *Physical and chemical properties of seals*

When tested in accordance with the methods detailed in **A.3** the component shall comply with the requirements given in table A.1.

A.2.3 *Physical and chemical properties of diaphragms*

When tested in accordance with the methods detailed in **A.3** the component shall comply with the requirements given in table A.2.

A.3 Tests methods for components

In addition to the conditions below reference should be made to table A.3.

A.3.1 *General*

Components which are greater than 2 mm thickness shall be cut to provide test samples of thickness 2 mm or less.

Where the active working area of the component consists of reinforced materials the test described in **A.4** and **A.5** shall be carried out on such reinforced materials.

A.3.2 *Hardness*

Five measurements shall be taken using the micro-hardness test method on three components at a test temperature of (23 ± 2) °C.

a) if the declared nominal hardness is 85 IRHD or less use ISO 48;

b) if the declared nominal hardness is greater than 85 IRHD use ISO 1400.

A.3.3 *Resistance to ageing*

Three components shall be tested in accordance with ISO 188 using a normal air oven under the following special conditions:

— duration of ageing: $(168^{\ 0}_{-2})$ h;

— test temperature: see table A.3.

A.3.4 *Resistance to gas*

Three components shall be tested in accordance with **8.2** of ISO 1817 : 1985 and the conditions detailed below. The minimum sample weight is 0,5 g; if each component weighs less than 0,5 g use a number of components.

— immerse for $(72^{\ 0}_{-2})$ h at (23 ± 2) °C in *n*-pentane.

NOTE. 98 % minimum *n*-pentane by mass, estimated by gas chromatography.

After removal from the liquid, wipe dry rapidly and weigh immediately.

Determine the change in mass with reference to the initial mass of the sample.

Dry as follows:

a) for components of thickness at the active working surface greater than 0,4 mm, dry for a period of $(168^{\ 0}_{-2})$ h in a normal air oven at (40 ± 2) °C;

b) for components of thickness at the active surface of 0,4 mm or less, dry in a normal air oven for $(96^{\ 0}_{-2})$ h at (40 ± 2) °C.

Determine the new change in mass with reference to the initial mass of sample.

Calculate the arithmetic mean values of the three results both after immersion and after drying.

A.3.5 *Resistance to lubricants*

Three components shall be tested in accordance with clause **8.2** (gravimetric method) and clause **11.2** (hardness test) of ISO 1817 : 1985 and the following special conditions:

— components shall be of a minimum sample weight of 0,5 g; if each component weighs less than 0,5 g use a number of components;

— immerse for $(168^{\ 0}_{-2})$ h in oil no. 2 at the test temperature given in table A.3;

— determine the change in mass and the change in hardness with reference to that of the initial samples.

Calculate the arithmetic mean values of the results after immersion.

Table A.1 Requirements for component seals

Property	Unit	Components of 2 mm thickness	Components of < 2 mm thickness
Hardness [1] Tolerance on stated nominal hardness	IRHD	± 5	± 5
Resistance to ageing Change in hardness max.	IRHD	± 10	± 10
Resistance to gas [2] — Change in mass after immersion, max.	%	+10 − 5	+10 − 9
— Change in mass after drying, max.	%	+5 −8	+ 5 −12
Resistance to lubricants [3] — Change in hardness, max.	IRHD	± 10	± 10
— Change in mass, max.	%	+15 −10	+15 −10
Resistance to ozone [4]		no cracks	no cracks

[1] For components of less than 3 mm cross-section the requirement for hardness tolerance is $^{+5}_{-7}$ IRHD

[2] For silicone seals there is no requirement for change in mass after immersion as swelling by some such materials may be substantial and the requirement for change in mass after drying is ± 5 %.

[3] For silicone seals the requirement for change in hardness and mass are ± 15 IRHD and $^{+10}_{-1}$% respectively.

[4] This requirement is only applicable if the seal has been declared by the manufacturer to be ozone resistant.

Table A.2 Requirements for component diaphragms

Property	Unit	Components of 2 mm thickness			Components of < 2 mm thickness		
Hardness [1] Tolerance on stated nominal hardness	IRHD	± 5			± 5		
Resistance to ageing Change in hardness max.	IRHD	± 8			± 8		
Resistance to gas		Hardness class			Hardness class		
		H1	H2	H3	H1	H2	H3
Change in mass after immersion, max.	%	+10 −10	+10 − 5	+10 − 5	+10 −15	+10 −10	+10 − 9
Change in mass after drying max.	%	+ 5 −15	+ 5 −10	+5 −8	+ 5 −20	+ 5 −15	+ 5 −12
Resistance to lubricants Change in hardness, max.	IRHD	± 10			± 10		
Change in mass, max.	%	+15 −10			+15 −10		
Resistance to ozone [2]		no cracks			no cracks		

[1] For components of less than 3 mm cross-section the requirement for hardness tolerance is $^{+5}_{-7}$ IRHD

[2] This requirement is only applicable if the diaphragm has been declared by the manufacturer to be ozone resistant.

A.3.6 *Resistance to ozone*

Components shall be tested in accordance with ISO 1431-1 : 1989 method A using:

- duration of test ($24^{0}_{-0,5}$) h;
- concentration of ozone (50 ± 5) pphm by volume;
- test temperature (30 ± 2) °C;
- relative humidity < 65 %
- no elongation.

Table A.3 Test methods for components

Property	ISO	Number of test pieces	Test temperature °C	Duration of test h	Remarks
Hardness	48 or 1400	Preferably 3	23 ± 2	—	—
Resistance to ageing	188	—		—	Normal oven
— hardness	48 or 1400	Preferably 3	Class A1, A2 70 ± 1 B1, B2 100 ± 1 C1, C2 125 ± 1 D1, D2 150 ± 1 E1, E2 175 ± 1	168^{0}_{-2}	
Resistance to gas — immersion in *n*-pentane	1817	Preferably 3 Minimum weight 0,5 g	23 ± 2	72^{0}_{-2}	Weigh and determine the change in mass
— drying	—		40 ± 2	168^{0}_{-2} or 96^{0}_{-2}	Use the arithmetic mean value, both after immersion and drying For components less than 2 mm thick
Resistance to lubricants — immersion in oil No. 2	1817	Preferably 3 Minimum weight 0,5 g	Class A1, A2 60 ± 1 B1, B2 80 ± 1 C1, C2 100 ± 1 D1, D2 100 ± 1 E1, E2 100 ± 1	168^{0}_{-2}	Determine the increase in mass and the change in hardness
Resistance to ozone	1431/1 Method A	Preferably 3	30 ± 2	$24^{0}_{-0,5}$	Using an ozone concentration of (50 ± 5) pphm no elongation view with 7-fold magnification

Annex B (normative)

Verification of components by infra-red spectrometric method

B.1 Scope

This normative annex specifies the requirements and test methods to enable the verification and quality control to be undertaken between rubber components used in the production of gas appliances and equipment against the previous type-tested material complying with this standard, using infra-red spectrometric examination of both extract and pyrolysates of the rubber. The solvent extract and ash content are also determined.

B.2 Requirements

B.2.1 *General*

Components shall be free from porosity, inclusions, blisters and surface imperfections visible to the naked eye, even after cutting.

For reinforced diaphragms there shall be no sign of delamination upon receipt nor after testing in accordance with methods laid down in annex **A.3.4** and **A.3.5**.

B.2.2 *Solvent extract*

The difference in extract content determined according to **B.3.2** on samples of type-tested sheet material and of components shall be no greater than 20 %.

B.2.3 *Infra-red spectra*

The infra-red spectra from extract according to **B.3.2** and pyrolysates prepared according to **B.3** from components shall be identical to the corresponding reference spectra produced from the type-tested sheet material (see note to **B.3.1**).

B.2.4 *Ash content*

The difference in ash content determined according to **B.3.4** on samples of type-tested sheet material and of components shall be no greater than 20 %.

B.3 Methods of test

B.3.1 *General*

The test specified in **B.3.2** to **B.3.4** shall be performed as comparison examination on samples taken from the type-tested sheet material and from the components.

NOTE. Components taken from gas appliances or equipment contaminated with lubricant shall normally not be used for the tests described below, since ingredients of the lubricants may have migrated into the rubber component. If no uncontaminated components are available these components can be used after they have been thoroughly cleaned from lubricants with absorbent paper or cotton wool.

Nevertheless the content of extractable material and the infra-red spectra of such components both from extract and pyrolysate may differ from uncontaminated reference samples. In such cases, the manufacturer of the gas appliance or equipment should supply uncontaminated components from the same batch to those used in the production of the appliances or equipment.

Examination of rubber from reinforced diaphragms shall be performed only on the rubber material separated from the reinforcement.

B.3.2 *Solvent extraction*

A weighted rubber sample is extracted according to ISO 1407 with solvent. The solvent shall be selected in consideration with the type of rubber. After the solvent has been completely removed from the extract, the amount of extract is determined.

B.3.3 *Infra-red spectra*

The extracted rubber samples are subjected to pyrolyses according to ISO 4650 clause **7.1** or equivalent methods, heating the samples for 5 min in an electric furnace brought to a temperature of (475 ± 25) °C. Spectra of the pyrolysate and the extract (see **B.3.2**) are obtained according to ISO 4650 clause **7.1.10** to **7.1.13**. Instead of taking the infra-red spectrum of the rubber pyrolisate the rubber itself may be analysed, e.g. by ATR.

B.3.4 *Ash content*

The ash content of the rubber samples is determined according to ISO 247.

List of references

See national foreword.

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