BRITISH STANDARD

BS 2494 : 1990

Implementing Amendment No. 1 not published separately

Specification for

Elastomeric seals for joints in pipework and pipelines

ICS 23.040.80

Foreword

This British Standard has been prepared under the direction of the Rubber Standards Policy Committee and supersedes BS 2494 : 1986, which is withdrawn.

BS EN 681-1 contains requirements that supersede those for types W, D, H and S in BS 2494 : 1990.

BS EN 681-2, to be published shortly, will supersede requirements for Type T.

BS EN 682, when published, will supersede requirements for Type G.

NOTE. The manner in which seals are stored between manufacture and use is most important and it is recommended that the advice given in appendix G is followed.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced personnel.

To assure themselves that products claimed to comply with BS 2494 consistently achieve the required level of quality, purchasers ordering to this standard are advised to specify in their purchasing contract that the supplier operates a quality system in compliance with BS 5750 : Part 2.

WARNING. This standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken.

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

Summary of pages

The following table identifies the current issue of each page. Issue 1 indicates that a page has been introduced for the first time by amendment. Subsequent issue numbers indicate an updated page. Vertical sidelining on replacement pages indicates the most recent changes (amendment, addition, deletion).

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Issue 2, December 1997 BS 2494 : 1990

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Specification

1 Scope

This British Standard specifies performance requirements and gives methods of test for one type of elastometric joint seal made of thermosetting elastomeric compounds and one type of joint seal made of thermoplastic elastomeric compounds (see clause 2) and the compounds from which they are manufactured. It is applicable to elastomeric components of composite or non-composite rings, seals, jointing gaskets, and similar components used to seal fluids in pipes and fittings.

Other requirements for the performance of the finished joint seals, particularly functional tests for the performance of the actual sealing systems used with particular pipeline materials, are specified in appropriate British Standards. Methods of test are given in appendices A and C to F. Recommendations for the storage of seals are given in appendix G.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Designation

Elastomeric joint seals shall be designated according to their intended application as given in table 1.

3 General

3.1 Materials

Seals of thermosetting elastomers shall be manufactured from compounds that are free from reclaimed rubber, vegetable oils, factice and vulcanized waste. Seals of type T shall be manufactured from material that consists substantially of thermoplastic elastomers to which may be added only those additives necessary for their manufacture and processing into sound durable mouldings. These seals may also contain the manufacturer's own clean rework material resulting from the manufacture of seals to this standard. No other rework material shall be used.

3.2 Hardness

Seals shall be classified in two different hardness ranges, as given in tables 5 and 6.

When measured in accordance with the microtest described in BS 903 : Part A26, the hardness shall not differ by more than 3 IRHD from the specified nominal value.

NOTE 1. It is common commercial practice for the seal hardness to be specified by the purchaser.

NOTE 2. Although BS 903 : Part A26 states that the microtest is preferably for use in the hardness range 30 IRHD to 85 IRHD, for application to joint seals it is considered to be suitable for measurements up to 91 IRHD.

3.3 Appearance and finish

The seals shall be smooth and free from air marks and other blemishes.

The elastomeric material forming the seals shall be homogeneous and free from porosity, as judged without magnification, on the surface or on any cut section.

If a seal exhibits flash, it shall not impair the sealing properties of the seal. Flash shall be kept to a minimum and neither the thickness nor the width of the flash shall exceed the values given in table 2 relative to the nominal dimension of the seal section.

Table 2. Flash size

Nominal dimensions of seal section	Maximum flash thickness and/or width	Flash size designation*
mm	mm	
⩽ 5	0.10	F.1
> 5 to 10	0.20	F.2
> 10 to 16	0.40	F.3
> 16 to 25	0.50	F.4
> 25 to 40	0.60	F.5
> 40 to 65	0.70	F.6
> 65	0.80	F.7

*These designations are for guidance only and may be referred to by joint seal designers.

Table 1. Designation of elastomeric joint seals by type and application

Type	Intended application
T (drainage)	Thermoplastic rubbers for above ground drainage only
G (gas and hydrocarbon fluids)	Town gas and other hydrocarbon gases as described in appendix B of BS 1179 : 1967 or in BS 4250 or 1st and 2nd family gases as defined in BS 4947. Hydrocarbon fluids with an aromatic content of not more than 30 %, and not including edible oils

3.4 Dimensional tolerances

The tolerances on dimensions of finished seals shall be in accordance with class M2 of BS 3734 for moulded products and class E1 of BS 3734 for extruded products.

The tolerance on the diameter of seals made from cut and jointed lengths of vulcanized material shall be in accordance with class M2 of BS 3734.

3.5 Splice joined seals

3.5.1 *Materials.* Any materials used to assist in making splice joints shall not detract from the performance of the seal type concerned.

3.5.2 *Strength.* There shall be no visible separation in the area of the splice when a jointed seal or linear test piece is tested as described in appendix A.

3.6 Moulding integrity (weld lines and gatemarks)

When tested in accordance with appendix F injection moulded seals of the type T, gated so as to produce a weld line, shall not exhibit damage resulting from the elongation when examined in good light, without magnification.

3.7 Composite seals

Each elastomeric component of a composite seal shall comply with all the other requirements of this standard for the corresponding type of seal designated in table 1, except for those components that will not be exposed to the contents of the pipeline or pipework.

NOTE. Different elastomeric components of a composite seal may be selected from different hardness ranges.

3.8 Quality assurance

NOTE. For advice on quality systems see foreword.

3.8.1 *Type tests.* All tests for the appropriate designation of seal shall be carried out at least annually and whenever the manufacturing technique is changed.

All tests, without exception, shall also be carried out whenever the elastomer formulation is changed. All of these tests shall either be carried out using test pieces cut from the finished seals or, if the shape of the seal does not permit test pieces to be produced, on laboratory samples of the same formulation, and same state of cure and method of preparation as the finished seals in the case of thermosetting elastomeric compounds and the same moulding conditions in the case of thermoplastic materials.

For tests in which different sizes of test pieces are permissible, the same size of test piece shall be used for each batch (see **3.8.3**) and for any comparative purposes.

In the case of thermoplastic materials test pieces shall be taken from the same mould for comparative purposes. Directions in which dumb-bells shall be cut are indicated in either figure 1(a) or 1(b).

3.8.2 *Product control tests.* The following tests shall be carried out according to the conditions listed in the appropriate tables 5 and 6, using test pieces in accordance with **3.8.1**, obtained as specified in **3.8.3**:

(a) tensile strength;

(b) elongation at break;

(c) compression set, 22 h at 70 °C for types W, D and G, 22 h at 125 °C for types H and S or 70 h at 23 °C for type T;

(d) hardness;

(e) splice strength (where applicable), see **3.5**;

(f) moulding integrity for type T where applicable.

3.8.3 *Sampling for product control tests.* The product control tests shall be carried out on batches of finished components using sampling procedures in accordance with either:

(a) BS 6001 with a specified inspection level of S–2 and an AQL of 2.5 % for attributes; or

(b) BS 6002 with a specified inspection level of S–3 and an AQL of 2.5 % for variables.

NOTE. These requirements do not preclude the use by the manufacturer of more stringent combination of inspection levels and AQL values from BS 6001 or BS 6002.

3.9 Marking

Each seal shall be marked clearly and durably with the following information in a manner that does not interfere with the sealing function of the seal.

(a) The nominal size.

NOTE 1. Joint seals are generally characterized by a nominal size defined not by this specification but by the pipework pipeline or joint system indicated by the manufacturer as that for which the particular size and shape of seal is designed.

(b) The manufacturer's identification.

(c) The number of this British Standard, i.e. BS 2494 : 1990 with the seal type designation (see clause **2**) as a suffix, with or without inclusion of the date of this standard, e.g. 'BS 2494 : 1990 : G' or 'BS 2494 : I'

(d) The quarter and year of manufacture.

NOTE 2. The following information is also desirable:

(1) the British Standard abbreviation for the elastomer used (see BS 3502 : Part 3 where applicable);

(2) the type of joint for which the seal is intended.

In cases where marking the actual component is not practicable (e.g. when sections are too small), seals shall be supplied in parcels and each parcel shall be marked with the above information. In such cases, every seal shall carry

* Marking BS 2494 : 1990 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

the manufacturer's identification unless this interferes with the sealing function.

4 *Text deleted*

5 *Text deleted*

6 Seals of type T (above ground drainage)

The physical properties of type T seals shall be as given in table 5.

7 Seals of type G (gas and hydrocarbon fluids)

The physical properties of type G seals shall be as given in table 6.

8 *Text deleted*

Table 3 *Table deleted*

Table 4 *Table deleted*

Table 5. Physical properties for seals of type T (thermoplastic elastomers for above ground use only)

Property	Unit	Test method	Test piece (see 3.8)	Hardness range			
				36 to 45	46 to 55	56 to 65	66 to 75
Tensile strength, min.	MPa	BS 903 : A2	BS 903 : A2 type 2 or as in appendix C*	4	4	4	6
Elongation at break, min.	%	BS 903 : A2	As above	400	375	300	300
Hardness (microtest)	IRHD	BS 903 : A26	2 mm minimum thickness*	Within 3 ° of specified hardness			
Compression set, max., 23 °C, 70 h	%	BS 903 : A6	BS 903 : A6 type 1 or 5 mm dia. X 3.5 mm or 7 mm dia. X 3.5 mm*	25	25	25	25
70 °C, 22 h				40	40	40	40
Stress relaxation, max.	%	BS 903 : A42 23 °C	BS 903 : A42 type 1	15	20	25	25
Water absorption, swell, max.	%	BS 903 : A16 volumetric method, 70 °C, 168 h	As specified	6	6	6	6
Low temperature hardness change, max. from 23 °C value (normal test)	IRHD	Appendix D 0 °C, 70 h	As specified*	5	5	5	5
Ozone test	–	BS 903 : A43 : procedure A, 5 % strain, 30 °C, 24 h, 10 ± 5 p.p.h.m. ozone†, 55 ± 5 % r.h.	As specified	No cracking visible under X7 magnification			
Accelerated ageing, 70 °C, 168 h		BS 903 : A19 : method A or B‡					
Tensile strength, max. change from original	%	BS 903 : A2	Same type of dumb-bell as used for 23 °C test	10	10	10	10
Elongation at break, max. change from original	%	BS 903 : A2	As above	10	10	10	10
Hardness (microtest) max. change from original	IRHD	BS 903 : A26	2 mm minimum thickness*	5	5	5	5

*The same size of test piece is required to be used for each batch and for any comparative purposes (see **3.8.1**).
†10 ± 5 p.p.h.m. = 10 ± 5 X 10^{-10} % (*V*/*V*).
‡Attention is drawn to the restrictions on method B given in **6.2** of BS 903 : A19 : 1975.

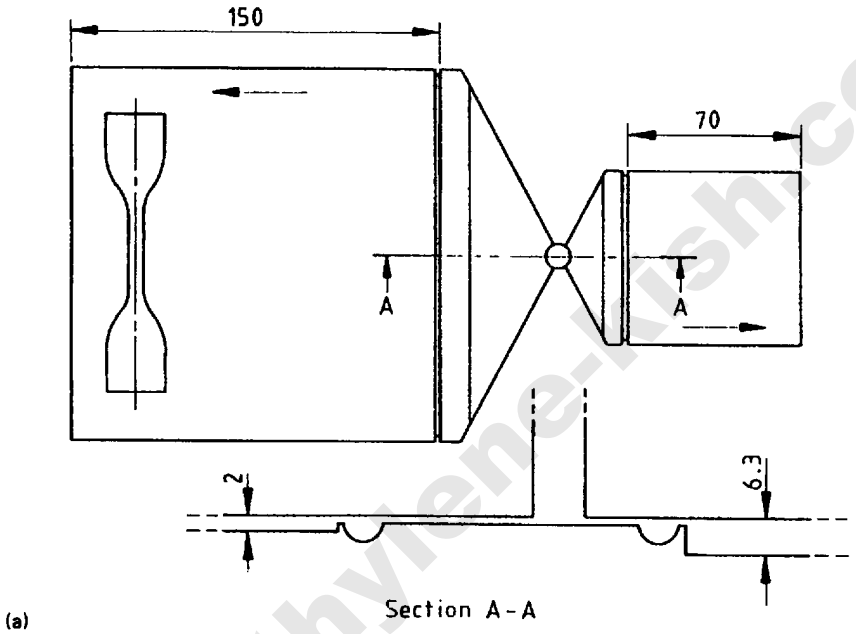
Previous pages

Table 6. Physical properties for seals of type G (gas and hydrocarbon fluids)

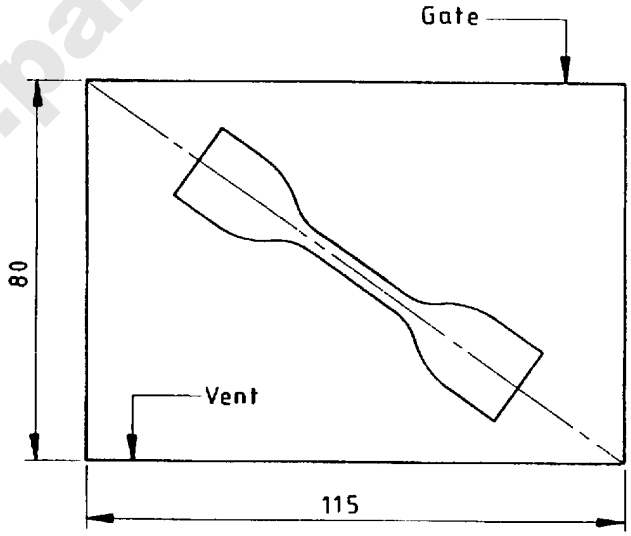
Property	Unit	Test method	Test pieces (see 3.8)	Hardness range				
				46 to 55	56 to 65	66 to 75	76 to 84	85 to 91
Tensile strength, min.	MPa	BS 903 : A2	BS 903 : A2 type 2 or as in appendix C*	9	9	9	9	9
Elongation at break, min.	%	BS 903 : A2	As above	400	300	200	150	100
Hardness (microtest)	IRHD	BS 903 : A26	2 mm minimum thickness*	Within 3 ° of specified hardness				
Compression set, max., 23 °C, 70 h	%	BS 903 : A6	BS 903 : A6 type 1 or 5 mm dia. X 3.5 mm or 7 mm dia. X 3.5 mm*	8	8	8	8	8
Compression set, max. 70 °C, 22 h	%	BS 903 : A6	As above	12	12	12	12	12
Compression set, max. −5 °C, 70 h after 30 min. recovery at the test temperature	%	BS 903 : A39	As above	20	20	20	20	20
Stress relaxation, max.	%	BS 903 : A42 23 °C	BS 903 : A42 type 1	10	10	10	10	10
Ozone test	–	BS 903 : A43 : procedure A, 20 % strain, 40 °C, 48 h, 25 p.p.h.m.† ozone, 55 ± 5 % r.h.	As specified	No cracking visible under X 7 magnification				
Liquid immersion tests								
Volume increase, max.	%	Appendix E		30	30	30	30	30
Hardness change, max.	IRHD	Appendix E	2 mm sheet	16	15	15	14	12
Tensile strength, min.	MPa	Appendix E	BS 903 : A2 type 2 dumb-bell or as in appendix C*	4.5	5	5	5	5
Elongation at break, min.	%	Appendix E	As above	225	175	125	100	75
Desorption tests								
Volume loss, max.	%	Appendix E		15	12	10	10	10
Accelerated ageing, 70 °C, 168 h		BS 903 : A19 : method A or B‡						
Tensile strength, max. change from original	%	BS 903 : A2	Same type of dumb-bell as used for 23 °C test	10	10	10	10	10
Elongation at break, max. change from original	%	BS 903 : A2	As above	25	25	25	25	25
Hardness (microtest) max. change from original	IRHD	BS 903 : A26	2 mm minimum thickness*	5	5	5	5	5

*The same size of test piece is required to be used for each batch and for any comparative purposes (see 3.8.1).
†25 p.p.h.m. = 25 X 10^{-10} % (*V/V*).
‡Attention is drawn to the restrictions on method B given in 6.2 of BS 903 : A19 : 1975.

Table 7 *Table deleted*



(a) Section A-A



(b)

All dimensions are in millimetres.

Figure 1. Mould layout for sample plates

Appendices

Appendix A. Method of tensile testing for spliced joints

One specimen comprising, as appropriate, a splice joined seal or a linear test piece 200 mm long with a splice at the midpoint between two reference lines 100 mm apart is extended at a rate of 500 mm/min to a percentage extension dependent on the material hardness (see table 8) and then maintained at that extension for 60 s. The tension is then relaxed and the joint examined without optical magnification.

Table 8. Sustained extension for splice joints

Hardness	Extension
IRHD	%
Up to 75	100
76 to 84	75
85 to 91	50

Appendix B *Text deleted*

Figure 2 *Figure deleted*

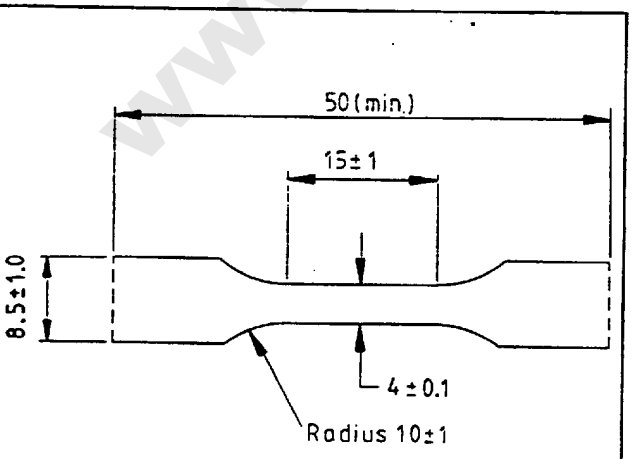
Figure 3 *Figure deleted*

Appendix C. Alternative tensile test piece

If an alternative test piece is used for carrying out tensile strength and elongation measurements in accordance with 3.8 and one of tables 3 to 7 as applicable, it shall be prepared as described in BS 903 : Part A2 and shall be of the dimensions shown in figure 4.

The thickness of the test piece shall be 1.5 mm maximum.

NOTE. This test piece is particularly suitable for testing seals that are too small to provide test pieces in accordance with type 2 of BS 903 : Part A2 but its use is not restricted to the testing of such seals.



All dimensions are in millimetres.

Figure 4. Dimensions of alternative dumb-bell

Appendix D. Method for measurement of low temperature hardness change

D.1 General

Using the test pieces in accordance with **3.8**, make hardness measurements as described in BS 903 : Part A26.

For testing flat surfaces, use the apparatus according to method N. Alternatively, for testing curved surfaces, use the apparatus according to method CN. Make one measurement at each of three or five different points distributed over the test piece and, where possible, at least 10 mm from its edge, and take the median of the results. Make all subsequent measurements at points at least 4 mm away from points used for any previous reading. Use the same hardness apparatus throughout any one test.

D.2 Initial hardness

Perform the test in accordance with **D.1**, but at the base temperature specified by this British Standard in either table 3 or table 4, as appropriate.

Record the result in IRHD as the initial hardness value.

D.3 Low temperature hardness

Using the same test piece(s) and test method as for **D.2**, perform the test using the low temperature specified by this British Standard in either table 4 or table 5, as appropriate, as follows.

Into a cold chamber maintained at the desired test temperature ± 2 °C, place the test piece(s) for the period specified in either table 3, 4 or table 5, as appropriate.

Condition the hardness apparatus and tweezers or tongs for at least 30 min in a cold chamber maintained at the desired test temperature ± 2 °C. Without disturbing the temperature of the test piece, make a further set of hardness readings using the tweezers or tongs for handling the test piece, or any associated supports, and gloves for handling the test equipment. Do not take measurements at points within 4 mm of those used for previous measurements. Record the result, in IRHD, as the low temperature hardness value.

NOTE. As an alternative to using hardness measuring apparatus in which the foot and indentor extend through the top of the chamber, hardness apparatus with suitable lubricants may be conditioned and operated inside the cold chamber. After measurements have been taken, it is advisable to dry all apparatus by removing it from the chamber and warming it with circulating air to approximately 40 °C.

D.4 Calculation of low temperature hardness change

Subtract the initial hardness result obtained in accordance with **D.2** from the low temperature hardness result obtained in accordance with **D.3** and report the difference as the low temperature hardness change, in IRHD.

Appendix E. Method for determining resistance to liquid immersion and desorption

Carry out the following tests in accordance with the appropriate clauses of BS 903 : Part A16 using liquid B, an immersion period of 168 h at 23 ± 2 °C and a volume ratio of liquid to rubber of not less than 50:1. Check that the increase in volume of any test piece does not exceed 30 % throughout the duration of the test.

For the measurement of swelling, use 2 mm thick test pieces. Measure the volume change after 22 h, 70 h and 168 h by the volumetric method described in **8.2** of BS 903 : Part A16 : 1987. After each period check that the volume change does not exceed 30 %.

Measure the changes in tensile properties and hardness after immersion by the method described in clause **10** of BS 903 : Part A16 : 1987. For tensile strength and elongation at break, use the appropriate dumb-bells for comparison and for hardness, use a 2 mm thick sheet. At the end of the test period, remove the test pieces from the liquid, wipe dry and measure the properties within 2 min of removal. The results shall comply with table 6.

Dry the test pieces used for volume change in air at 70 ± 2 °C for 96 h. Check that the loss in volume due to extraction of soluble material does not exceed the values given in table 6 when compared with the original dry value for any test piece.

Appendix F. Method for assessing the integrity of moulded seals of type T

Mount the seal on two pulleys or rollers one of which is attached to the fixed part of a tensile testing machine and the other to the moving part.

NOTE. When testing small seals up to 1½/40 nominal size one of the pulleys may be replaced by a smooth steel hook or pin not exceeding 8 mm in diameter.

Wherever possible place the seal so that its gate(s) and knit line(s) are not in contact with the pulleys during the test. Separate the pulleys at a rate of 500 mm/m until the original outside diameter of the seal has been increased by 100 %. Maintain this separation for 10 s. Remove the seal from the tensile testing machine and examine it for damage.

Obtain the value for separation of the centres of the pulleys for 100 % elongation of the seal from the following expression:

$$\pi (d - p)$$

where

d is the outside diameter of the spigot which is to enter the seal;

p is the diameter of pulleys or rollers.

NOTE. When testing small seals using one pulley and a pin, p is the average diameter of pulley and pin.

Appendix G. Recommendations for storage of seals

At all stages between manufacture and use it is recommended that the seals are stored in accordance with the following recommendations.

(a) The storage temperature should be below 25 °C and preferably below 15 °C.

(b) Joint seals should be protected from light, in particular direct sunlight and strong artificial light with a high ultraviolet content.

(c) As ozone is particularly deleterious, storage rooms should not contain any equipment that is capable of generating ozone, such as mercury vapour lamps, high voltage electrical equipment, electric motors or other equipment which may give rise to electric sparks or silent electrical discharges.

(d) Joint seals should, wherever possible, be stored in a relaxed condition free from tension, compression or other deformation.

Issue 2, December 1997

Publications referred to

BS 903	Methods of testing vulcanized rubber Part A2 Determination of tensile stress-strain properties Part A6 Determination of compression set after constant strain Part A16 Determination of the effect of liquids Part A19 Heat resistance and accelerated air ageing tests Part A26 Determination of hardness Part A39 Determination of compression set under constant deflection at low temperatures Part A42 Determination of stress relaxation Part A43 Determination of resistance to ozone cracking (static strain test)
BS 1179	Glossary of terms used in the gas industry
BS 3502	Schedule of common names and abbreviations for plastics and rubbers Part 3 Rubbers and latices
BS 3734	Specification for dimensional tolerances of solid moulded and extruded rubber products
BS 4250	Liquified petroleum gas
BS 4947	Specification for test gases for gas appliances
BS 5750*	Quality systems Part 2 Specification for production and installation
BS 6001	Sampling procedures for inspection by attributes
BS 6002	Specification for sampling procedures and charts for inspection by variables for percent defective

*Referred to for information only.

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The preparation of this British Standard was entrusted by the Rubber Standards Policy Committee (RUM/-) to Technical Committee RUM/1, upon which the following bodies were represented:

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British Plastics Federation
British Precast Concrete Federation Ltd.
British Rubber Manufacturers' Association
British Steel Industry
Clay Pipe Development Association Ltd.
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Institution of Water Engineers and Scientists
Malaysian Rubber Producers' Research Association
Ministry of Defence
Rubber and Plastics Research Association of Great Britain
Water Authorities Association
Water Companies Association
Water Research Centre

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Amd. No.	Date of issue	Text affected
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