

Physical testing of rubber —

Part 0: General

ICS 83.060

Committees responsible for this British Standard

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- British Rubber Manufacturers Association Ltd.
- RAPRA Technology Ltd.
- Royal Society of Chemistry
- Satra Technology Centre
- Tun Abdul Razak Research Centre

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Foreword

This British Standard has been prepared by Technical Committee PRI/22. It supersedes BS 903-0:1990 which is withdrawn.

BS 903 is the best-known British Standard for rubber and was first published as a compilation of test methods in 1940. It quickly developed an international reputation, especially in the Commonwealth and parts of Europe, and many of its methods were subsequently adopted as international (ISO) standards.

BS 903 is split into two series. Series A comprises the general methods of test A1–A65. Series C comprises the methods of test C1–C5, used to determine the electrical properties of vulcanized rubber.

The work of Subcommittee ISO/TC 45/SC2, Rubber and rubber products — Testing and analyses, continues in reviewing and revising international standards and in developing new test methods and guides to keep abreast of changes and developments in technology, and in this the UK plays a leading and active role. As a consequence, the status of methods is continually changing, as new editions are published and new methods appear. It is therefore never possible for this Part of BS 903 to be completely up-to-date and this present edition is therefore only a snapshot in time.

The purpose of this part is to provide a general introduction to the range of British and international Standard test methods used to determine the physical properties of rubber. (The methods embrace raw, unvulcanized, vulcanized and thermoplastic rubbers.)

A detailed and comprehensive cross-reference is given in Annex A of corresponding international standards; Annex B gives a list of those international standards issued by ISO/TC 45/SC2; and Annex C provides recommendations for the rounding-off of test results.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 19 and a back cover.

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1 Scope

This part of this British Standard provides a general introduction to BS 903 and to BS ISO standards in the BS 903 series. It describes a range of laboratory-scale methods for the physical testing of rubber in raw, unvulcanized, vulcanized and thermoplastic forms. A list of closely-related British Standards is also provided.

NOTE The status of methods referenced here should be verified with the relevant standards body; they are continually changing as new editions are issued and new methods appear, in line with developments in technology.

2 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 3558 apply.

3 Normative reference

BS 3558 (all parts), *Glossary of rubber terms*.

4 Reproducibility

A number of the test methods include a statement on test precision as determined by an interlaboratory test programme and ISO/TC 45 intends that this should eventually be extended to all methods. Attention is drawn to ISO/TR 9272 and ISO/TR 11753.

5 Test method categories and properties

5.1 General

The individual test methods published in the A series of BS 903 and as BS ISO standards are listed in Annex A. Most of the BS 903 A series test methods are identical with those standardized by Technical Committee ISO/TC 45, Rubber and rubber products, of the International Organization for Standardization (ISO) and, where this is so, the methods have been published as dual-numbered British Standards, although current practice is now to adopt ISO standards as BS ISO standards with the same ISO numbers. In all cases the ISO equivalents are also listed. Additional methods are in preparation.

Annex B gives a full list of those international standards issued by ISO/TC 45/SC2.

The methods fall into seven main categories:

- a) tests for unvulcanized rubber;
- b) preparative procedures;
- c) mechanical tests;
- d) viscoelastic tests;
- e) degradation and environmental tests;
- f) tests on effect of fluids;
- g) adhesion and contact property tests.

In terms of these categories the existing parts of BS 903 and BS ISO standards can be grouped as in 5.2 to 5.8, although there will be some overlap.

NOTE The prefix BS 903 applies to the referenced standards unless otherwise indicated.

5.2 Tests for unvulcanized rubber

5.2.1 *Mooney viscometer tests*

Mooney viscosity	A58:1990 (incorporating Amendments No. 1:1991 and No. 2:2001) (≠ ISO 289-1:1994 and ISO 289-2:1994) (partially replaced by A58.1:2001)
Delta Mooney (for non-pigmented, oil-extended, emulsion-polymerized SBR)	A58.1:2001 (≡ ISO 289-3:1999)
Prevulcanization characteristics	A58:1990 (incorporating Amendments No. 1:1991 and No. 2:2001) (≠ ISO 289-1:1994 and ISO 289-2:1994) (partially replaced by A58.1:2001)

5.2.2 *Plastimeter tests*

Rapid plasticity number	A59.1:1997 (≡ ISO 2007:1991)
Plasticity retention index	A59.2:1997 (≡ ISO 2930:1995)

5.2.3 *Curemeter tests*

Curemetering — Guide to the use of curemeters	A60.1:2000 (incorporating Amendment No. 1:2000) (≡ ISO 6502:1999)
Vulcanization characteristics using oscillating disc curemeter	A60.2:1992 (≡ ISO 3417:1991)

5.2.4 *Other tests*

Green strength of raw or unvulcanized rubber	A62:1993 (≡ ISO 9026:1991)
Assessment of carbon black dispersion	A65:1998 (≡ ISO 11345:1997)

NOTE BS 903-A65 is also applicable to vulcanized rubber.

5.3 Preparative procedures

5.3.1 *General*

For raw rubber, attention is also drawn to BS ISO 1795.

5.3.2 *Test compounds*

preparation, mixing and vulcanization	A64:1995 (≡ ISO 2393:1994)
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5.3.3 *Test pieces*

preparation of samples and test pieces	A36:1995 (≡ ISO 4661-1:1993)
measurement of dimensions	A38:1991 (≡ ISO 4648:1991)

5.3.4 *Test conditions*

standard laboratory atmospheres	A35:1995 (≡ ISO 471:1995)
general directions for achieving elevated or subnormal temperatures	A32:1988 (≡ ISO 3383:1985)

5.4 Mechanical tests

5.4.1 *Density*

A1:1996 (= ISO 2781:1988 incorporating Corrigendum No. 1:1996)

5.4.2 *Stress-strain properties*

in tension	A2:1995 (= ISO 37:1994)
in compression	A4:1990 (incorporating Amendment No. 1:1991) (= ISO 7743:1989 incorporating Corrigendum No. 1:1990)
in shear	A14:1992 (= ISO 1827:1991)
dynamic	BS ISO 4664:1998 (= ISO 4664:1998) and A31:1976 (incorporating Amendment No. 1:1986) (≠ ISO 4663:1986)

5.4.3 *Hardness*

IRHD	A26:1995 (incorporating Amendment No. 1:2001) (= ISO 48:1994 incorporating Amendment No. 1:1999)
by pocket hardness meters	A57:1997 (= ISO 7619:1997)

5.4.4 *Strength properties*

tensile	A2:1995 (= ISO 37:1994)
tear	A3:1995 (= ISO 34-1:1994) A3.2:1997 (= ISO 34-2:1996)
fatigue (by crack growth)	A10:1999 (= ISO 132:1999) A51:1986 (= ISO 6943:1984)

5.5 Viscoelastic tests

5.5.1 *Set and recovery*

in tension	BS ISO 2285:2001 (= ISO 2285:2001)
in compression	A6:1992 (incorporating Amendment No. 1:1994) (= ISO 815:1991 incorporating Corrigendum No. 1:1993)

5.5.2 *Creep*

A15:1990 (= ISO 8013:1988)

5.5.3 *Stress relaxation*

A42:1999 (incorporating Amendment No. 1:2001) (= ISO 3384:1999 incorporating Amendment No. 1:2001)

5.5.4 *Frictional properties*

A61:2000 (incorporating Amendment No. 1:2001) (= ISO 15113:1999 incorporating Corrigendum No. 1:2001)

5.5.5 *Crystallization effects*

A63:1995 (= ISO 3387:1994 incorporating Corrigendum No. 1:2000)

5.5.6 *Dynamic testing*

BS ISO 4664:1998 (= ISO 4664:1998)

A31:1976 (incorporating Amendment No. 1:1986) (≠ ISO 4663:1986)

5.5.7 *Resilience*

A8:1990 (≠ ISO 4662:1986)

5.5.8 Heat build-up

A49:1984 (≡ ISO 4666-1:1982)

A50:1984 (≡ ISO 4666-3:1982)

NOTE BS 903-A49 and -A50 may also be used to determine resistance to fatigue, creep and set caused by thermal degradation during flexure.

5.6 Degradation and environmental tests**5.6.1 Thermal and thermal-oxidative ageing**

accelerated ageing and heat resistance	A19:1998 (≡ ISO 188:1998)
by stress relaxation	A52:1986 (≡ ISO 6914:1985)
Estimation of life time and maximum temperature of use	BS ISO 11346 ¹⁾ (≡ ISO 11346 ²⁾)

NOTE BS 903-A6, -A15, -A42, -A49 and -A50 may also be used to measure the time-dependent thermal stability of vulcanized rubber under specified conditions.

5.6.2 Ozone and weathering resistance

static strain ozone exposure	A43:1990 (≡ ISO 1431-1:1989)
dynamic strain ozone exposure	A44:1995 (≡ ISO 1431-2:1994)
ozone concentration	A45:2000 (≡ ISO 1431-3:2000)
outdoor exposure	BS ISO 4665:1998 (≡ ISO 4665:1998)
artificial light exposure	BS ISO 4665:1998 (≡ ISO 4665:1998)
assessment of properties after weathering	BS ISO 4665:1998 (≡ ISO 4665:1998)

5.6.3 Low temperature properties

torsion modulus	A13:1990 (≡ ISO 1432:1988)
impact brittleness	A25:1992 (≡ ISO 812:1991)
temperature retraction	A29:1997 (≡ ISO 2921:1997)
compression set	A6:1992 (incorporating Amendment No. 1:1994) (≡ ISO 815:1991 incorporating Corrigendum No. 1:1993)
crystallization by hardness measurements	A63:1995 (≡ ISO 3387:1994 incorporating Corrigendum No. 1:2000)

5.7 Tests on effects of fluids

NOTE Attention is also drawn to BS ISO 13226.

resistance to liquids	A16:1999 (≡ ISO 1817:1999)
water vapour absorption	A18:1973 (no corresponding ISO)
gas permeability	A30:1996 (≡ ISO 2782:1995)
vapour transmission rate of volatile liquids (for rubber sheets and coated fabrics)	BS EN ISO 6179:2001 (incorporating Amendment No. 1:2001) (≡ ISO 6179:1998)

5.8 Adhesion and contact property tests**5.8.1 Adhesion strength****5.8.1.1 To fabrics:**

peel test	A12:1999 (≡ ISO 36:1999)
direct tension	A27:1986 (≡ ISO 4637:1979)

¹⁾ To be published; ISO 11346 not yet implemented by BSI.

²⁾ Published, see Bibliography.