BRITISH STANDARD

BS ISO 24453:2008

Rubber — Acquisition and presentation of comparable single-point data

ICS 83.060

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PRI/22, Physical testing of rubber.

A list of organizations represented on this committee can be obtained on request to its secretary.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2008

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ISBN 978 0 580 58339 1

Amendments/corrigenda issued since publication

Date	Comments

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BS ISO 24453:2008

INTERNATIONAL STANDARD

ISO 24453

First edition
2008-05-01

Rubber — Acquisition and presentation of comparable single-point data

Caoutchouc — Acquisition et présentation de données simples comparables

Reference number
ISO 24453:2008(E)

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Foreword

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ISO 24453 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

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INTERNATIONAL STANDARD **ISO 24453:2008(E)**

Rubber — Acquisition and presentation of comparable single-point data

1 Scope

This International Standard identifies specific test procedures for the acquisition and presentation of comparable single-point data for properties of rubber compounds. In general, each property is specified by a single test method and a single experimental value although, in certain cases, properties may be represented by more than one value obtained under different test conditions. The properties presented are those used to characterize processing properties, those most often quoted by manufacturers and in material specifications, and those relevant to more specific applications. An important application of this International Standard consists in helping different suppliers produce material specification sheets in which the same set of properties is measured using the same conditions.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 34-1, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

ISO 36, *Rubber, vulcanized or thermoplastic — Determination of adhesion to textile fabric*

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 or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 289-1, *Rubber, unvulcanized — Determinations using a shearing-disc viscometer — Part 1: Determination of Mooney viscosity*

ISO 289-2, *Rubber, unvulcanized — Determinations using a shearing-disc viscometer — Part 2: Determination of pre-vulcanization characteristics*

ISO 812, *Rubber, vulcanized or thermoplastic— Determination of low-temperature brittleness*

ISO 813, *Rubber, vulcanized or thermoplastic — Determination of adhesion to a rigid substrate — 90° peel method*

ISO 815-1, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures — Part 1: At ambient or elevated temperatures*

ISO 815-2, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures — Part 2: At low temperatures*

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ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 1432, *Rubber, vulcanized or thermoplastic — Determination of low temperature stiffening (Gehman test)*

ISO 1817, *Rubber, vulcanized — Determination of the effects of liquids*

ISO 1827, *Rubber, vulcanized or thermoplastic — Determination shear modulus adhesion to rigid plates — Quadruple-shear method*

ISO 1853, *Conducting and dissipative rubbers, vulcanized or thermoplastic — Measurement of resistivity*

ISO 2007, *Rubber, unvulcanized — Determination of plasticity — Rapid-plastimeter method*

ISO 2285, *Rubber, vulcanized or thermoplastic — Determination of tension set under constant elongation, and of tension set, elongation and creep under constant tensile load*

ISO 2393, *Rubber test mixes — Preparation, mixing and vulcanization — Equipment and procedures*

ISO 2781, *Rubber, vulcanized and thermoplastic — Determination of density*

ISO 2782, *Rubber, vulcanized or thermoplastic — Determination of permeability to gases*

ISO 2921, *Rubber, vulcanized — Determination of low-temperature characteristics — Temperature-retraction procedure (TR test)*

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

ISO 3387, *Rubber — Determination of crystallization effects by hardness measurements*

ISO 3865, *Rubber, vulcanized or thermoplastic — Methods of test for staining in contact with organic material*

ISO 4649, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 4662, *Rubber — Determination of rebound resilience of vulcanizates*

ISO 4666-3, *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing — Part 3: Compression flexometer*

ISO 6179, *Rubber, vulcanized or thermoplastic — Rubber sheets and rubber-coated fabrics — Determination of transmission rate of volatile liquids (gravimetric technique)*

ISO 6502, *Rubber — Guide to the use of curemeters*

ISO 7743, *Rubber, vulcanized or thermoplastic – Determination of compression stress-strain properties*

ISO 8013, *Rubber, vulcanized — Determination of creep in compression or shear*

ISO 9026, *Raw rubber or unvulcanized compounds — Determination of green strength*

ISO 11345, *Rubber — Assessment of carbon black and carbon black/silica dispersion — Rapid comparative methods*

ISO 15113, *Rubber — Determination of frictional properties*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

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IEC 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

BS 903:A18, *Physical testing of rubber — Part A18: Determination of equilibrium water vapour absorption*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
single-point data
data characterizing a rubber material by means of those property tests in which important aspects of performance can be described with single-value results

4 Test piece preparation

Where relevant, materials for test shall be prepared, mixed and moulded following the general principles given in ISO 2393.

The detailed conditions used shall be as recommended by the manufacturer of the rubber compound and shall, for each of the processing steps, be the same for each test piece except that different cure times may be used for different sized test pieces.

The equipment, mixing cycle and conditions used for moulding shall be given in the test report.

The final preparation of test pieces (for example stamping from sheet) shall be in accordance with the relevant test method standard.

The properties of a rubber compound can vary depending on the processing procedures used and this should be taken into account when comparing materials.

To maximize the usefulness of results, processing conditions should be representative of those used in production.

5 Conditioning

The time between mixing and moulding shall be between 24 h and one week.

The time between moulding and conditioning shall be between 16 h and four weeks. Recommendations for the storage of vulcanized rubber products are given in ISO 2230.

Test pieces shall be conditioned in accordance with the relevant test method standard. Where this refers to standard laboratory conditions of temperature and/or humidity, these are taken to mean (23 ± 2) °C and 50 % RH.

NOTE If tests are carried out at the alternative standard laboratory temperature of (27 ± 2) °C, the results will not be strictly comparable unless adjusted by the known relationship of the property with temperature.

For tests at temperatures other than (23 ± 2) °C, where specific instructions are not included in the test method standard, condition the test pieces at the temperature at which the test is to be conducted for a period sufficient to enable test pieces to attain substantial equilibrium in accordance with ISO 23529.

Details of the conditioning used shall be given in the test report.

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6 Processability properties

If processability data are required (for example if unvulcanized material is being supplied), the test methods, test conditions and units shall be selected from those specified in Table 1.

The test temperature(s) shall be as considered appropriate for the material in question.

NOTE The measurement of viscoelastic flow and cure properties of rubber compounds is essential for the processor in order to form the material efficiently and effectively into the required product. However, these properties are generally of little consequence for the end user of the product and it is for this reason that processability properties are considered separately to other properties in this International Standard.

Table 1 — Test methods for processability data

Property		Symbol	International Standard	Unit	Test conditions
1.1	Mooney viscosity	See ISO 289-1	ISO 289-1	Mooney units	Large rotor
1.2	Mooney scorch time	t_x	ISO 289-2	min	Rise of 5 MU
2.1	Rapid plasticity number		ISO 2007	0,01 mm	
3.1	Time to 90 % cure (The cure curve is normally presented.)	$t'_c(90)$	ISO 6502	min	Preference is given to an oscillating die instrument. The temperature is selected according to the compound and expected processing conditions.
3.2	Time to 50 % cure	$t'_c(50)$	ISO 6502	min	
3.3	Scorch time	t_{sx}	ISO 6502	min	
3.4	Minimum torque	M_L	ISO 6502	Nm	
3.5	Plateau torque (Maximum torque or torque after a specified time, if appropriate)	M_{HF} (M_{HR} or M_H)	ISO 6502	Nm	
4.1	Green strength (yield or maximum stress)		ISO 9026	MPa	Use beaded type 1 test piece.
4.2	Carbon black dispersion		ISO 11345	Dimensionless	Method A or B

7 Test requirements

The test methods, test conditions and units specified in Table 2 shall be used when determining data according to this International Standard.

A property may be omitted if it is not relevant to the material in question (for example fluid resistance, if a compound is not for use in oil or fuel).

It is not essential to measure both compression and tension set, the choice being dependent on the material and the intended application.

If required, additional properties may be presented using the test methods, test conditions and units specified in Table 3. It is recommended that all properties relevant to the intended end use of the material be presented.

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Unless otherwise specified in the tables or the test method standard, properties shall be measured at standard laboratory temperature and, where appropriate, humidity, in an air atmosphere in accordance with ISO 23529.

NOTE 1 The properties listed in Table 2 are those usually included in data sheets whilst those listed in Table 3 will generally only be relevant when specific applications are being considered.

NOTE 2 Symbols for properties are given in Tables 1 to 3 where these are designated in the test method standard.

8 Presentation of results

Processability data, when required, shall be presented in accordance with the requirements of the test method standards used.

The data for the properties listed in Tables 2 and 3 shall be presented as shown by these tables. Test the minimum number of test pieces that is specified for each property in the associated test method standard. Record the test result in the "value" column (this is usually the mean or median value). For properties where the temperature of test and/or the liquid used has(have) to be selected, report the temperature(s) and fluid(s). Precede the data with information that identifies the material together with the information required by Clauses 4 and 5.

In order that the value recorded for each property be as representative as possible of the material tested, the measurements are preferably made on test pieces obtained from a number of batches of material blended together. Alternatively, the average of results from several sets of test pieces produced from different batches may be presented.

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Table 2 — Test conditions and format for the presentation of single-point data

Property		Symbol	International Standard	Test piece	Value	Unit	Test conditions
1 Mechanical properties							
1.1	Hardness		ISO 48	Standard (N)		°SN [a]	Method N
1.2	Tensile strength	TS_b	ISO 37	Type 1 or 1A [b]		MPa	Dumbbell cut in grain direction
1.3	Elongation at break	E_b	ISO 37	Type 1 or 1A		%	Dumbbell cut in grain direction
1.4	Stress at 100 % elongation	S_{100}	ISO 37	Type 1 or 1A		MPa	Dumbbell cut in grain direction
1.5	Stress at 300 % elongation	S_{300}	ISO 37	Type 1 or 1A		MPa	Dumbbell cut in grain direction
1.6	Tear strength	T_s	ISO 34-1	Crescent		kN/m	Method C Test piece cut in grain direction
1.7	Density		ISO 2781	$\geqslant$ 2,5 g		Mg/m^3	Method A
2 Viscoelastic properties							
2.1	Compression set	C	ISO 815-1	Type A [b], moulded		%	24 h [c] Lubricated platens
2.2	Tension set	E_4	ISO 2285	Enlarged ends, 50 mm reference length		%	Constant elongation 100 % Method A 24 h [c]
2.3	Resilience		ISO 4662	Standard		%	
3 Degradation and environmental tests							
3.1	Heat ageing		ISO 188				Method A 72 h [c]
3.2	Change in hardness		ISO 48	Standard (M)		°SM	Method M
3.3	Change in tensile strength		ISO 37	Type 1 or 1A		%	
3.4	Change in elongation		ISO 37	Type 1 or 1A		%	
3.5	Low-temperature stiffness	RM 10	ISO 1432	Standard		°C	
3.6	Brittleness temperature		ISO 812	Type B		°C	Procedure A
3.7	Volume change Fluid resistance	ΔV_{100}	ISO 1817	1 cm^3 to 3 cm^3 2 mm thick		%	72 h [d]
3.8	Ozone resistance		ISO 1431-1	Standard strip		Description	Procedure A 72 h at 50 pphm 40 °C
3.9	Abrasion resistance index	ARI	ISO 4649	Standard		%	Method B Reference compound 2

[a] The degree sign ° indicates International Rubber Hardness Degrees (IRHD).

[b] The type 1 dumbbell, the type 1A dumbbell and the type A compression set test piece have been chosen because their larger size, compared to alternatives, aids precision.

[c] The test temperature(s) will depend on the material and the intended end use. Where relevant, the temperature should be selected from those specified in the material specification. For most general-purpose rubbers, 70 °C or 100 °C is appropriate.

[d] The test temperature(s) and the fluid(s) will depend on the material and the intended end use. Where relevant, the temperature should be selected from those specified in the material specification. For most general-purpose rubbers, 70 °C or 100 °C is appropriate. The fluid(s) shall be selected from the reference liquids given in ISO 1817. For general purposes, oils 1 and 3 and fuel B are appropriate.

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Table 3 — Test conditions and format for the presentation of single-point data — Additional properties

Property		Symbol	Standard	Test piece	Value	Unit	Test conditions
1 Mechanical properties							
1.1	Shear modulus	G	ISO 1827	Standard		N/mm^2	Method A
1.2	Compression modulus		ISO 7743	Standard, moulded		MPa	Method A 20 % strain
2 Viscoelastic properties							
2.1	Creep	$\Delta\varepsilon$	ISO 8013	Type A, moulded		Dimensionless	Creep increment in compression after 167 h Use mechanical conditioning.
2.2	Stress relaxation	R(10000)	ISO 3384	Standard cylinder, moulded		%	Method A Stress relaxation after 167 h
3 Electrical properties							
3.1	Surface resistivity	ρ_α	IEC 60093	2 mm thick sheet		Ω	500 V
3.2	Volume resistivity	ρ	IEC 60093	2 mm thick sheet		Ω·cm	500 V
3.3	Resistivity (semi-conducting)	ρ	ISO 1853	Standard		Ω·m	
4 Degradation and environmental tests							
4.1	Low-temperature retraction	TR50	ISO 2921	Standard, 100 mm		°C	50 % elongation 50 % retraction
4.2	Low-temperature set	C	ISO 815-2	Type A, moulded		%	24 h [a]
4.3	Crystallization effects		ISO 3387	Standard (N)		°SN	Change of hardness after 168 h [a]
5 Other properties							
5.1	Friction		ISO 15113	Sheet		Dimensionless	Procedure A Stainless steel 0,4 µm R_a 50 mm/min, 50 N
5.2	Heat build-up	$\Delta\theta$	ISO 4666-3	Standard		°C	1 MPa pre-stress, 4,45 mm stroke. Start at 23 °C.
5.3	Staining		ISO 3865	Sheet		Description	Method A, acrylic stoving enamel, 24 h light exposure, visual assessment
5.4	Gas permeability	Q	ISO 2782	Standard		$m^2/Pa{\cdot}s$	Constant volume method 1 atm driving pressure of oxygen
5.5	Vapour transmission	Q	ISO 6179	Standard		$g/m^2{\cdot}h$	[b]
5.6	Water vapour absorption	V	BS 903:A18	Standard		%	
5.7	Adhesion to rigid substrates		ISO 813	Standard		N/mm	[c]
5.8	Adhesion to fabric		ISO 36	Standard		N/mm	[c]

[a] The test temperature(s) will depend on the material and the intended end use. For low-temperature set, −40 °C is commonly specified. For crystallization effects, the temperature is preferably the nearest standard temperature to that at which the crystallization rate is maximum for the polymer in question.

[b] The test fluid shall be selected from the reference liquids given in ISO 1817. For general purposes, fuel B is appropriate.

[c] State the substrate and adhesive system used.

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Bibliography

[1] ISO 2230, *Rubber products — Guidelines for storage*

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Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
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