INTERNATIONAL STANDARD

ISO 1433

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Rubber, vulcanized — Preferred gradations of properties

Caoutchouc vulcanisé — Gradations préférées des propriétés

Reference number
ISO 1433:1995(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 1433 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products.*

This second edition cancels and replaces the first edition (ISO 1433:1984), of which clauses 2 and 4 and the table have been technically revised.

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Introduction

This International Standard is intended to serve as a guide to international committees and national bodies responsible for the specification of rubber materials. It is stressed that this International Standard does not constitute a specification, but that the intention is that the derived property limit will be selected from the list provided so that unnecessary variations in requirements for rubber materials can be avoided.

The values given for each property are representative of the values that can be achieved with existing rubber materials, but no one rubber material is expected to meet the whole range provided. Each property is considered individually, and therefore any combination of limits for different properties is not necessarily obtainable. Acceptable properties should be agreed between the parties concerned. The individual gradations should as far as possible be selected from those given in this International Standard, but it is recognized that the list will not be acceptable for all purposes.

The gradations listed in this International Standard have been used in ISO 4632:—, *Rubber, vulcanized — Classification system* [to be published (revision of ISO 4632-1:1982)] and ISO/TR 8461:1984, *Rubber, vulcanized — Classification — Rubber materials,* to which reference should be made for the classification of existing rubber materials.

Rubber, vulcanized — Preferred gradations of properties

1 Scope

This International Standard lays down preferred numerical values for the gradation of various physical properties of solid vulcanized rubber determined in accordance with standard methods of test.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 34-1;1994, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces.*

ISO 36:1993, *Rubber, vulcanized or thermoplastic — Determination of adhesion to textile fabric.*

ISO 37:1994, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties.*

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 132:1983, *Rubber, vulcanized — Determination of flex cracking (De Mattia).*

ISO 133:1983, *Rubber, vulcanized — Determination of crack growth (De Mattia).*

ISO 188:1982, *Rubber, vulcanized — Accelerated ageing or heat-resistance tests.*

ISO 812:1991, *Rubber, vulcanized — Determination of low-temperature brittleness.*

ISO 813:1986, *Rubber, vulcanized — Determination of adhesion to metal — One-plate method.*

ISO 814:—[1], *Rubber, vulcanized — Determination of adhesion to metal — Two-plate method.*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures.*

ISO 816:1983, *Rubber, vulcanized — Determination of tear strength of small test pieces (Delft test pieces).*

ISO 1399:1982, *Rubber, vulcanized — Determination of permeability to gases — Constant volume method.*

ISO 1431-1:1989, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static strain test.*

ISO 1431-2:1994, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 2: Dynamic strain test.*

ISO 1432:1988, *Rubber, vulcanized or thermoplastic — Determination of low temperature stiffening (Gehman test).*

ISO 1817:1985 *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 1827:1991, *Rubber, vulcanized or thermoplastic — Determination of modulus in shear or adhesion to rigid plates — Quadruple shear method.*

1) To be published. (Revision of ISO 814:1986)

ISO 1853:1975, *Conducting and antistatic rubbers — Measurement of resistivity.*

ISO 2285:1988, *Rubber, vulcanized or thermoplastic — Determination of tension set at normal and high temperatures.*

ISO 2782:1995, *Rubber, vulcanized or thermoplastic — Determination of permeability to gases.*

ISO 2878:1987, *Rubber, vulcanized — Antistatic and conductive products — Determination of electrical resistance.*

ISO 2921:1982, *Rubber, vulcanized — Determination of low temperature characteristics — Temperature-retraction procedure (TR-test).*

ISO 2951:1974, *Vulcanized rubber — Determination of insulation resistance.*

ISO 3384:1991, *Rubber, vulcanized or thermoplastic — Determination of stress relaxation in compression at ambient and at elevated temperatures.*

ISO 3387:1994, *Rubbers — Determination of crystallization effects by hardness measurements.*

ISO 3865:1983, *Rubber, vulcanized — Methods of test for staining in contact with organic materials.*

ISO 4649:1985, *Rubber — Determination of abrasion resistance using a rotating cylindrical drum device.*

ISO 4662:1986, *Rubber — Determination of rebound resilience of vulcanizates.*

ISO 4666-3:1982, *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing — Part 3: Compression flexometer.*

ISO 5600:1986, *Rubber — Determination of adhesion to rigid materials using conical shaped parts.*

ISO 6505:1984, *Rubber, vulcanized — Determination of adhesion to, and corrosion of, metals.*

3 List of properties

3.1 General

The properties have been considered in groups, as follows:

— mechanical properties;

— heat resistance and accelerated ageing;

— ozone, weather and light resistance;

— compression set and tension set;

— stress relaxation and creep;

— resistance to liquids (including chemical resistance);

— dynamic properties;

— low-temperature resistance;

— electrical properties;

— staining and contact properties;

— adhesion properties;

— permeability.

The property group is indicated in column 1 of table 1, the properties being listed in column 2.

3.2 Gradation of values for properties

Gradations have been given only for those properties for which an International Standard specifies a method of test. Other properties will be considered for inclusion when appropriate methods of test have been standardized.

The gradations are listed in column 5 of table 1, column 3 indicating the appropriate units and column 4 indicating whether the values are maxima or minima or indicating tolerances.

If the dimensions of a rubber product do not permit the use of the standard test piece, an alternative test piece may be used. In this case, the results may differ from those obtainable using the standard test piece, and the acceptable deviations shall be agreed between the manufacturer and the purchaser.

3.3 Methods of test

The reference number of the International Standard specifying the method of test for the determination of each property is given in column 6 of table 1.

4 Method of use of this International Standard

Find the property to be specified in table 1 and examine the list of preferred gradations given alongside. Select the gradation or gradations most appropriate for the material being specified and for the test conditions being used.

It should be recognized that no relationship is intended between gradations given for different properties. Each group of gradations is independent of any other. For example, a rubber material having the lowest hardness gradation (20 IRHD) will not necessarily have the lowest tensile strength (3 MPa).

In the case of tests for heat resistance and resistance to liquids, two gradations may be required for a given property, one applying to a permissible increase and the other to a permissible decrease. Care shall be taken to ensure that such combinations are practicable. Thus the gradation "0" may be used to indicate that either no increase or no decrease in property is allowed, but it shall not be used for both.

These two gradations, in the case of change in tensile strength and change in elongation at break, shall be selected so that the range between the two values will not be less than 20 %. For example, "0" and "− 20" and "−10" and "+10" give acceptable ranges; "+5" and "− 5", and "0" and "+10" do not give acceptable ranges.

Table 1 — List of properties, their preferred gradations and methods of test

1	2	3	4	5	6
Property group	**Property**	**Unit**	**Maximum or minimum or tolerances**	**Gradations**	**Method of test**
Mechanical properties	Hardness	IRHD	+5 −4	20; 30; 40; 50; 60; 70; 80; 90	ISO 48
	Tensile strength	MPa	min.	3; 5; 7; 10; 14; 17; 20; 25; 30; 35; 40	ISO 37
	Elongation at break	%	min.	50; 100; 150; 200; 250; 300; 350; 400; 450; 500; 600; 700	ISO 37
	Stress at specified elongation	MPa	range (min. to max.)	< 0,8; 0,8 to 1,5; 1,6 to 3,0; 3,1 to 7,0; 7,1 to 10,0; 10,1 to 15,0; 15,1 to 20,0; 20,1 to 25,0; 25,1 to 30,0; 30,1 to 35,0	ISO 37
	Modulus in shear	MPa	range (min. to max.)	0,20 to 0,30; 0,31 to 0,40; 0,41 to 0,60; 0,61 to 0,80; 0,81 to 1,0; 1,1 to 1,5; 1,6 to 2,5; 2,6 to 4,0	ISO 1827
	Tear strength (trouser test piece)	kN/m	min.	2; 5; 10; 20; 30; 40	ISO 34-1
	Tear strength (angle test piece)	kN/m	min.	5; 10; 15; 20; 30; 60; 90	ISO 34-1
	Tear strength (crescent test piece)	kN/m	min.	5; 10; 15; 20; 30; 60; 90	ISO 34-1
	Tear strength (Delft test piece)	N	min.	10; 30; 50; 70; 90; 110	ISO 816
	Abrasion resistance index	—	min.	40; 60; 90; 120; 160; 220; 300; 400	ISO 4649
Heat resistance and accelerated ageing	Increase in hardness Decrease in hardness	IRHD IRHD	max. max.	25; 20; 15; 10; 5; 0 20; 15; 10; 5; 0	ISO 188 ISO 48
	Increase in tensile strength Decrease in tensile strength	% %	max. max.	0; 10; 20; 30 60; 50; 40; 30; 20; 10; 0	ISO 188 ISO 37
	Increase in elongation at break Decrease in elongation at break	% %	max. max.	0; 10; 20; 30 60; 50; 40; 30; 20; 10; 0	ISO 188 ISO 37

Table 1 — List of properties, their preferred gradations and methods of test *(continued)*

1	2	3	4	5	6
Property group	**Property**	**Unit**	**Maximum or minimum or tolerances**	**Gradations**	**Method of test**
Ozone weather and light resistance	Ozone resistance				
	— Static strain conditions: threshold strain	%	min.	10; 20; 30; 40; 50; 60; 80; 100; 120	ISO 1431-1
	— Dynamic strain conditions: time to first crack	h	min.	16; 24; 48; 72	ISO 1431-2
Compression set and tension set	Compression set under constant deflection	%	max.	80; 60; 50; 45; 40; 35; 30; 25; 20; 15; 10	ISO 815
	Tension set under constant elongation	%	max.	80; 60; 50; 40; 30; 25; 20; 15; 10; 5	ISO 2285
Stress relaxation and creep	Stress relaxation in compression	%	max.	30; 25; 20; 15; 10; 5	ISO 3384
	Stress relaxation in compression with immersion in liquid	%	max.	30; 25; 20; 15; 10; 5	ISO 3384 ISO 1817
Resistance to liquids (including chemical resistance)	Change in volume				
	— increase	%	max.	140; 120; 100; 80; 70; 60; 50; 40; 35; 30; 25; 20; 15; 10; 5; 0	ISO 1817
	— decrease	%	max.	20; 15; 10; 5; 0	
	Change in mass				
	— increase	%	max.	140; 100; 80; 60; 50; 25; 15; 10; 5; 0	ISO 1817
	— decrease	%	max.	20; 15; 10; 5; 0	
	Change in hardness				
	— increase	IRHD	max.	30; 25; 20; 15; 10; 5; 0	ISO 1817
	— decrease	IRHD	max.	30; 25; 20; 15; 10; 5; 0	ISO 48
	Change in tensile strength				
	— increase	%	max.	0; 10; 20; 30	ISO 1817
	— decrease	%	max.	60; 50; 40; 20; 10; 0	ISO 37
	Change in elongation at break				
	— increase	%	max.	0; 10; 20; 30	ISO 1817
	— decrease	%	max.	60; 50; 40; 30; 20; 10; 0	ISO 37
Dynamic properties	Rebound resilience	%	min. or max.	10; 20; 30; 40; 50; 60; 70; 80; 90	ISO 4662
	Flexometer fatigue: compression flexometer test				
	— temperature rise	°C	max.	50; 40; 30; 20	ISO 4666-3
	— compression set	%	max.	60; 50; 40; 30; 25; 20; 15; 10; 5	
	— resistance to fatigue	cycles ($\times 10^3$)	min.	8; 15; 30; 60; 120; 250; 500	
	Flex resistance (de Mattia)				
	— flex cracking	cycles ($\times 10^3$)	min.	50; 100; 200; 500; 1 000	ISO 132
	— crack growth	cycles ($\times 10^3$)	min.	5; 10; 30; 50; 100; 200; 400	ISO 133

Table 1 — List of properties, their preferred gradations and methods of test (*end*)

1	2	3	4	5	6
Property group	**Property**	**Unit**	**Maximum or minimum or tolerances**	**Gradations**	**Method of test**
Low-temperature resistance	Brittleness temperature	°C	max.	0; −5; −10; −15; −20; −25; −30; −35; −40; −45; −50; −55; −60; −65; −70; −75; −80	ISO 812
	Torsional modulus test: T_2, T_5, T_{10}, T_{100} and temperature corresponding to 70 MPa max.	°C	max.	0; −5; −10; −15; −20; −25; −30; −35; −40; −45; −50; −55; −60; −65; −70; −75; −80	ISO 1432
	Compression set	%	max.	80; 60; 50; 40; 30; 25; 20; 15; 10	ISO 815
	Hardness increase	IRHD	max.	30; 25; 20; 15; 10; 5	ISO 3387 ISO 48
	Temperature retraction test (TR test): TR 10, TR 30, TR 50, TR 70	°C	max.	0; −5; −10; −15; −20; −25; −30; −35; −40; −45; −50; −55; −60; −65; −70; −75; −80	ISO 2921
Electrical properties	Volume resistivity	Ω·m	range (min. to max.)	$< 5 \times 10^2$; 5×10^2 to 5×10^6; 5×10^6 to 5×10^{10}; 5×10^{10} to 5×10^{14}; $> 5 \times 10^{14}$	ISO 1853
	Electrical insulation resistance	Ω	min. or max.	5×10^4; 5×10^6; 5×10^8; 5×10^{10}; 5×10^{12}; 5×10^{14}; 5×10^{16}	ISO 2951 ISO 2878
Staining and contact properties	Staining in contact with organic materials — degree of staining	grey scale	range (max. to min.)	< 1; 1; 3 to 2; 5 to 4 (see note 1)	ISO 3865
	Corrosion of metals			See note 2	ISO 6505
Adhesion properties	Adhesion to textiles	KN/m	min.	1; 2; 3; 4; 5; 6; 7; 8	ISO 36
	Adhesion to metal				
	— one-plate method	kN/m	min.	3; 6; 9; 12; 15; 18; 21; 24	ISO 813
	— two-plate method	MPa	min.	1; 1,5; 2; 3; 5; 7; 9	ISO 814
	Adhesion to rigid material				
	— to rigid plate in shear	MPa	min.	0,5; 1,0; 1,5; 2,0; 2,5; 3,0; 4,0; 5,0; 6,0; 8,0	ISO 1827
	— to conical ends of rigid material	N	min.	0,5; 1,0; 1,5; 2,0; 2,5; 3,0; 4,0; 5,0; 6,0; 8,0; 10,0	ISO 5600
Permeability	Permeability to gases (CV)	$m^2 \cdot Pa^{-1} \cdot s^{-1}$ ($\times 10^{-17}$)	max.	2; 5; 10; 15; 20; 25; 30; 40; 50; 60; 80; 100	ISO 1399
	Permeability to gases (CP)	$m^2 \cdot Pa^{-1} \cdot s^{-1}$ ($\times 10^{-17}$)	max.	2; 5; 10; 15; 20; 25; 30; 40; 50; 60; 80; 100	ISO 2782

NOTES

1 In accordance with ISO 3865, these gradations correspond respectively to severe staining, moderate staining, slight staining and no staining as assessed by visual inspection.

2 In ISO 6505, the degree of metal corrosion is assessed by visual inspection in accordance with the following criteria:

a) no surface stain or corrosion;

b) surface stain or discoloration, but no pitting or erosion;

c) corrosion as evidenced by pitting or erosion.

ICS 83.060

Descriptors: rubber, vulcanized rubber, physical properties, classification.

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