International Standard 1433

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Rubber, vulcanized — Preferred gradations of properties

Caoutchouc vulcanisé — Gradations préférées des propriétés

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1433 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*, and was circulated to the member bodies in December 1982.

It has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	Spain
Austria	Hungary	Sri Lanka
Belgium	India	Sweden
Canada	Italy	Turkey
China	Malaysia	United Kingdom
Czechoslovakia	New Zealand	USA
Egypt, Arab Rep. of	Poland	USSR
France	South Africa, Rep. of	

No member body expressed disapproval of the document.

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Rubber, vulcanized — Preferred gradations of properties

0 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 (see clause 4).

The property 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 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 the list will not be acceptable for all purposes.

The gradations listed in this International Standard have been used in ISO 4632/1 and ISO/TR 8461 to which reference should be made for the classification of existing rubber materials.

1 Scope and field of application

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 References

ISO 34, *Rubber, vulcanized — Determination of tear strength (trouser, angle and crescent test pieces).*

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

ISO 37, *Rubber, vulcanized — Determination of tensile stress-strain properties.*

ISO 48, *Vulcanized rubbers — Determination of hardness (Hardness between 30 and 85 IRHD).*

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

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

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

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 812, *Rubber, vulcanized — Determination of brittleness temperature.*

ISO 813, *Vulcanized rubber — Determination of adhesion to metal — One-plate method.*

ISO 814, *Vulcanized rubber — Determination of adhesion to metal — Two-plate method.*

ISO 815, *Rubber, vulcanized — Determination of compression set at normal and at high temperatures.*

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

ISO 1325, *Plastics — Determination of electrical properties of thin sheet and film.*

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

ISO 1400, *Vulcanized rubbers of high hardness (85 to 100 IRHD) — Determination of hardness.*

ISO 1431/1, *Rubber, vulcanized — Resistance to ozone cracking — Part 1 : Static strain test.*

ISO 1432, *Rubber, vulcanized — Determination of stiffness at low temperature (Gehman test).*

ISO 1653, *Vulcanized rubbers — Determination of compression set under constant deflection at low temperatures.*

ISO 1747, *Rubber, vulcanized — Determination of adhesion to rigid plates in shear — Quadruple shear test.*

ISO 1817, *Vulcanized rubbers — Resistance to liquids — Methods of test.*

ISO 1818, *Vulcanized rubbers of low hardness (10 to 35 IRHD) — Determination of hardness.*

ISO 1827, *Rubber, vulcanized — Determination of modulus in shear — Quadruple shear method.*

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

ISO 2285, *Vulcanized rubbers — Determination of tension set under constant elongation at normal and high temperatures.*

ISO 2782, *Rubber, vulcanized — Determination of permeability to gases — Constant pressure method.*

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

ISO 2921, *Vulcanized rubber — Determination of low temperature characteristics — Temperature-retraction procedure (TR-test).*

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

ISO 3384, *Rubber, vulcanized — Determination of stress relaxation in compression at normal and at elevated temperatures.*

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

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

ISO 4632/1, *Rubber, vulcanized — Classification — Part 1 : Description of the classification system.*

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

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

ISO 4663, *Rubber — Determination of dynamic behaviour of vulcanizates at low frequencies — Torsion pendulum method.*

ISO 4664, *Rubber — Determination of dynamic properties of vulcanizates for classification purposes (by forced sinusoidal shear strain).*

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

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

ISO 6505, *Rubber, vulcanized — Determination of adhesion to, and corrosion of, metals.*[1]

ISO/TR 8461, *Rubber, vulcanized — Classification — Rubber materials.*[1]

3 List of properties

3.1 General

The properties have been considered in property groups, as follows :

- mechanical properties;
- heat resistance;
- 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 the table, 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 the table, column 3 indicating the appropriate units and column 4 indicating whether the values are maximum or minimum or any 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 should be agreed between the manufacturer and the purchaser.

3.3 Methods of test

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

4 Method of use of this International Standard

Find the property to be specified in the table 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.

1) At present at the stage of draft.

NOTE — 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 should be taken to ensure 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 should not be used for both.

It should be recognized that no relationship is intended between gradations given for different properties. Each group of gradation 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).

Table — 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 ISO 1400 ISO 1818
	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; 4,1 to 8,0; 8,1 to 16,0; 16,1 to 31,0	ISO 1827
	Tear strength (crescent test piece)	kN/m	min.	5; 10; 15; 20; 30; 60; 90; 120; 150	ISO 34
	Tear strength (angle test piece)	kN/m	min.	5; 10; 15; 20; 30; 60; 90; 120; 150	ISO 34
	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	Increase in hardness	IRHD	max.	25; 20; 15; 10; 5; 0	ISO 188 ISO 48
	Decrease in hardness	IRHD	max.	20; 15; 10; 5; 0	ISO 1400 ISO 1818
	Increase in tensile strength	%	max.	0; 10; 20; 30	ISO 188
	Decrease in tensile strength	%	max.	60; 50; 40; 30; 20; 10; 0	ISO 37
	Increase in elongation at break	%	max.	0; 10; 20; 30	ISO 188
	Decrease in elongation at break	%	max.	60; 50; 40; 30; 20; 10; 0	ISO 37
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
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.	50; 40; 30; 25; 20; 15; 10; 5	ISO 3384
	Stress relaxation in compression with immersion in liquid	%	max.	50; 40; 30; 25; 20; 15; 10; 5	ISO 3384 ISO 1817

Table — 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**
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.	30; 25; 20; 15; 10; 5; 0	
	Change in mass				
	— increase	%	max.	140; 100; 80; 60; 50; 25; 15; 10; 5; 0	ISO 1817
	— decrease	%	max.	25; 15; 10; 5; 0	
	Change in hardness				
	— increase	IRHD	max.	30; 20; 15; 10; 5; 0	ISO 1817 ISO 48 ISO 1400 ISO 1818
	— decrease	IRHD	max.	30; 20; 15; 10; 5; 0	
	Change in tensile strength				
	— increase	%	max.	0; 10; 20; 30	ISO 1817 ISO 37
	— decrease	%	max.	50; 40; 30; 20; 10; 0	
	Change in elongation at break				
	— increase	%	max.	0; 10; 20; 30	ISO 1817 ISO 37
	— decrease	%	max.	50; 40; 30; 20; 10; 0	
Dynamic properties	Rebound resilience	%	min. or max.	10; 20; 30; 40; 50; 60; 70; 80; 90	ISO 4662
	Torsion pendulum test				
	— Complex shear modulus (G^*)	MPa	± 0,10	0,25; 0,50; 0,75; 1,00; 1,25; 1,50; 2,00; 2,50; 3,00; 3,50; 4,00; 4,50; 5,00; 6,00; 8,00; 10,00	ISO 4663
	— Damping as loss factor	tan δ	max.	0,02; 0,05; 0,10; 0,15; 0,20; 0,25; 0,30; 0,40; 0,60; 0,80; 1,00	
	Forced sinusoidal shear strain test				
	— Complex shear modulus (G^*)	MPa	± 0,10	0,25; 0,50; 0,75; 1,00; 1,25; 1,50; 2,00; 2,50; 3,00; 3,50; 4,00	ISO 4664
	— Damping as loss factor	tan δ	max.	0,02; 0,05; 0,10; 0,15; 0,20; 0,25; 0,30; 0,40; 0,60; 0,80; 1,00	
	Flexometer fatigue compression flexometer test				
	— temperature rise	°C	max.	120; 100; 80; 60; 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.	1; 2; 4; 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 — 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 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 1653
	Hardness increase	IRHD	max.	60; 50; 40; 30; 25; 20; 15; 10; 5	ISO 3387 ISO 48 ISO 1400 ISO 1818
	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 10^6; 5×10^6 to 10^{10}; 5×10^{10} to 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
	Breakdown voltage	MV/m	min.	5; 10; 15; 20	ISO 1325
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
	Adhesion to metal — 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 1747
	— 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 According to 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 according to 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 and erosion.