International Standard ISO 4632/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Rubber, vulcanized — Classification — Part 1 : Description of the classification system

Caoutchouc vulcanisé — Classification — Partie 1 : Description du système de classification

First edition — 1982-08-01

UDC 678.063.001.33 **Ref. No. ISO 4632/1-1982 (E)**

Descriptors : rubber, vulcanized rubber, classifications.

Price based on 10 pages

Preisgr. F

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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 4632/1 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*, and was circulated to the member bodies in June 1979.

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

Belgium	Germany, F.R.	Spain
Brazil	Hungary	Thailand
Canada	India	Turkey
China	Italy	United Kingdom
Czechoslovakia	Poland	USA
Denmark	Romania	USSR
Egypt, Arab Rep. of	South Africa, Rep. of	

No member body expressed disapproval of the document.

Printed in Switzerland

Rubber, vulcanized — Classification — Part 1 : Description of the classification system

0 Introduction

This International Standard has been prepared in order to provide a reference classification system for vulcanized rubbers based on their physical properties.

It is to be used as a source of material quality "line call-out" designations on procurement documents and drawings, and for the preparation of specifications for rubber products.

Commercially available vulcanized rubber materials classified by the system described in this International Standard and intended to cover the majority of applications will be listed in part 2 of this International Standard.[1)]

1 Scope and field of application

1.1 This International Standard describes a system for the classification and designation of solid vulcanized rubbers serving a wide range of industrial needs.

1.2 The classification system is based on the premise that the properties of all vulcanized rubbers can be arranged into characteristic material designations. These designations are determined by **Type**, based on resistance to heat ageing, by **Class**, based on resistance to swelling in oil, and by **Group**, based on low temperature resistance. The combined use of Type, Class and Group, and the values for basic and additional properties, permits the complete description of the quality of any vulcanized rubber, referred to hereafter as "material".

1.3 The purpose of this classification system is to provide guidance to purchasers and suppliers in the selection of practical, commercially available materials and further to provide a method of specifying these materials by the use of a simple "line call-out" designation.

1.4 The classification system for the materials described in this International Standard will provide more information about rubber as a material in specifications. It will also save the user effort in the selection of suitable materials, and prevent the user from specifying impractical and impossible combinations of properties.

1.5 In all cases where the provisions of this classification system would conflict with those of detailed specifications for a particular product, the latter shall take precedence.

NOTE — If the rubber product is to be used for purposes for which the requirements are too specific to be completely described by this classification system, it will be necessary for the purchaser to consult with the supplier to secure adjustment of the properties to suit the actual conditions of service in which the product is to be used.

1.6 This classification system has been developed to permit the addition of descriptive values for future materials, without complete reorganization of the classification system, and to facilitate the incorporation of future methods of test to keep pace with the changing requirements of industry.

2 References

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

ISO/R 36, *Determination of the adhesion strength of vulcanized rubbers to textile fabrics.*

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, *Vulcanized rubbers — Determination of resistance to flex cracking (De Mattia type machine).*

ISO 133, *Rubber, vulcanized — Determination of 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/R 812, *Method of test for temperature limit of brittleness for vulcanized rubbers.*

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

1) It is intended to publish ISO 4632/2 as a Technical Report.

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

ISO 815, *Vulcanized rubber — Determination of compression set under constant deflection at normal and high temperatures.*

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

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 — Determination of resistance to ozone cracking — Part 1 : Static strain test.*

ISO 1431/2, *Rubber, vulcanized — Determination of resistance to ozone cracking — Part 2 : Dynamic strain test.*

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

ISO 1433, *Rubber, solid vulcanized — List of properties, their preferred gradations and methods of test.*[1)]

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 method.*

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, *Rubber, vulcanized — 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 2921, *Rubber, vulcanized — 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 material.*

ISO 4649, *Rubber, vulcanized — Determination of abrasion resistance using a rotating cylindrical drum device.*[1)]

ISO 4661, *Rubber — Preparation of test pieces.*

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 4666/1, *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing — Part 1 : Basic principles.*

ISO 4666/2, *Rubber, vulcanized — Determination of temperature rise and resistance to fatigue in flexometer testing — Part 2 : Rotary flexometer.*

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

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

3 Classification system

3.1 General

In this classification system, materials are classified and described in terms of their physical properties as assessed by standard laboratory methods of test. These properties, and the test conditions used, are denoted by means of letter designations and numerical codes designed to facilitate the classification and identification of each material and its requirements.

Each material is initially categorized by the three classification criteria described in 3.2, with further categorization by a group of basic physical properties as described in 3.3 and, if required, by additional properties as described in 3.4.

3.2 Classification criteria

3.2.1 General

For the purpose of this classification system, the three classification criteria for materials are :

a) heat resistance,

b) oil resistance, and

c) low temperature resistance.

1) At present at the stage of draft.

These classification criteria are used to establish a characteristic material designation consisting of three capital letters, where

— the first letter signifies Type (heat resistance);

— the second letter signifies Class (oil resistance);

— the third letter signifies Group (low temperature resistance).

Thus, for example, when a material designation is indicated as BCD, "B" stands for Type, "C" stands for Class, and "D" stands for Group.

3.2.2 **Type** (heat resistance)

Type is determined by the maximum temperature at which heat (air oven) ageing for 70 h in accordance with ISO 188 causes a change in tensile strength of not more than ± 30 %, a change in elongation at break of not more than − 50 % and a change in hardness of not more than ± 15 IRHD. The temperatures at which materials shall be tested for determining Type are listed in table 1.

Table 1 — Heat ageing temperatures for establishing Type

Type	Test temperature °C
A	70
B	100
C	125
D	150
E	175
F	200
G	225
H	250
J	275
K	300

NOTES

1 The temperatures given in table 1 have been taken from ISO 471.

2 Since laboratory heat ageing tests are of relatively short term, a material is not necessarily suitable for extended use in any particular application at the assigned Type-temperature.

The words "relatively short term" are related to this table only, i.e. an ageing period of 70 h as one of the conditions of the classification criteria.

3.2.3 **Class** (oil resistance)

Class is based on the resistance of the material to swelling in oil No. 3, when tested in accordance with ISO 1817.

In the test, the immersion time shall be 70 h and the oil temperature shall be the Type-temperature (see table 1), or 150 °C, whichever is the lower.

NOTE — 150 °C has been chosen as the highest temperature, as representing the limit of oil stability. Materials designated as Types E, F, G, H, J and K are tested at this temperature to establish Class.

Limits of volume swelling for each Class are shown in table 2.

Table 2 — Limits of volume swelling for establishing Class

Class	Volume swelling % max.
A	> 140 (or not specified)
B	140
C	120
D	100
E	80
F	60
G	40
H	30
J	20
K	10
L	5

3.2.4 **Group** (low temperature resistance)

Group is based on the brittleness temperature of the material, when measured in accordance with ISO/R 812. The limiting brittleness temperatures for each Group are shown in table 3.

Table 3 — Limiting brittleness temperatures for establishing Group

Group	Limiting brittleness temperature °C max.
A	0
B	−10
C	−25
D	−40
E	−55
F	−75
G	−85

NOTE — The temperatures given in table 3 have been taken from ISO 471.

3.2.5 Significance of Type, Class and Group

The selection of Type (heat resistance) is understood to be indicative of the inherent heat resistance that can normally be expected from commercial compositions. Similarly, the choice of Class (oil resistance) is based on the range of volume swelling normally expected from such commercial compositions as established by Type. Finally, the choice of Group (low temperature resistance) is understood to be indicative of the inherent low temperature resistance that can normally be expected of commercial compositions.

3.2.6 Examples of material designations

3.2.6.1 The designation BCD designates a material of Type B, Class C and Group D. This material resists temperatures up to 100 °C (as defined in 3.2.2), with volume swelling not exceeding 120 % in oil No. 3 (as defined in 3.2.3), and is non-brittle at −40 °C (as defined in 3.2.4).

3.2.6.2 The designation DHB designates a material of Type D, Class H and Group B. This material resists temperatures up to 150 °C (as defined in 3.2.2), with volume swelling not exceeding 30 % in oil No. 3 (as defined in 3.2.3), and is non-brittle at −10 °C (as defined in 3.2.4).

3.3 Basic physical properties

3.3.1 For the purpose of this classification system, the basic physical properties are as follows (the appropriate unit symbol is shown in parentheses) :

a) hardness (IRHD);

b) tensile stength (MPa);

c) elongation at break (%);

d) compression set (%).

These basic properties are indicated by a four digit numerical code, where

— the first digit signifies a range of hardness;

— the second digit signifies a minimum tensile strength;

— the third digit signifies a minimum elongation at break;

— the fourth digit signifies a maximum compression set determined at the Type-temperature.

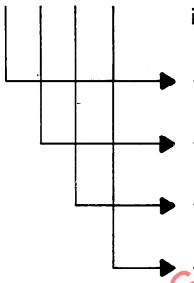
3.3.2 The numerical coding system for the basic physical properties is given in table 4. This table is to be used only as a coding system for **established materials**.

3.3.3 The values of the physical properties given in table 4 are obtained using standard laboratory test pieces, prepared and tested in accordance with the relevant International Standard methods of test.

NOTE — If test pieces can be cut from finished rubber products in accordance with ISO 4661 and the appropriate International Standard methods of test, a deviation in the values of the physical properties given in table 4 is permissible by agreement between the purchaser and the supplier.

3.3.4 Example of a code for basic physical properties :

The code 5 3 7 3 defines a material with the following properties :



— hardness in the range 46 to 55 IRHD;

— tensile strength of at least 7 MPa;

— elongation at break of at least 400 %;

— compression set not exceeding 50 % after 22 h at Type-temperature.

3.4 Additional properties

3.4.1 General

If additional properties, that either supersede or supplement the basic requirements given in 3.2 and 3.3, are required, these properties and the methods of test to be used shall be indicated by means of suffix letters and numbers. Suffix Grade numbers are used to specify the additional properties and their values.

Table 4 — Numerical coding system for basic physical properties

Hardness IRHD		Tensile strength MPa min.		Elongation at break % min.		Compression set at Type-temperature 22 h, % max.	
Code	**Values**	**Code**	**Values**	**Code**	**Values**	**Code**	**Values**
0	not specified	0	not specified	0	not specified	0	not specified
1	10 to 15	1	3	1	50	1	80
2	16 to 25	2	5	2	100	2	60
3	26 to 35	3	7	3	150	3	50
4	36 to 45	4	10	4	200	4	40
5	46 to 55	5	14	5	250	5	30
6	56 to 65	6	17	6	300	6	25
7	66 to 75	7	20	7	400	7	20
8	76 to 85	8	25	8	500	8	10
9	86 to 95	9	35	9	600	9	5
Methods of test ISO 1818 ISO 48 ISO 1400		**Method of test** ISO 37		**Method of test** ISO 37		**Method of test** ISO 815	

NOTE — The values for the properties given in table 4 have been selected from the preferred gradations given in ISO 1433.

3.4.2 Suffix letters

A suffix letter is used to indicate the property to be tested and should be taken from the list given in table 5. Two characters are used in the case of suffix letter "E".

Table 5 — Suffix letters to indicate additional properties

Suffix letter	Property
A	Heat resistance
B	Compression set and tension set
C	Ozone-, weather- and light resistance
D	Stress relaxation and creep
E*	Resistance to liquids
EO	Oil resistance
EF	Resistance to hydrocarbon liquids
EA	Aqueous fluid resistance
F	Low temperature resistance
G	Tear resistance
H	Flex resistance
J	Abrasion resistance
K	Adhesion
L	Impermeability to gases and water vapour
M	Flammability resistance
N**	Chemical resistance
O	Electrical properties
P	Staining and contact properties
R	Resilience
S	Dynamic properties
T	Static stress-strain properties
(U, V, W, X, Y)	(Reserved for new properties)
Z	Any special requirement which shall be specified in detail

* Suffix letter "E" comprises testing with liquids that cause a physical change due to swelling.

** Suffix letter "N" comprises testing with liquids that cause both a physical change due to swelling and a chemical change.

3.4.3 Suffix numbers

Each suffix letter should be followed by two suffix numbers to represent the test conditions applicable.

3.4.3.1 The first suffix number indicates the method of test and, when appropriate, the duration of the test. It should be taken from table 6.

For some of the properties listed in table 6, it has not been possible to give test conditions other than a reference to an International Standard. In such cases, the conditions of test and the method of expressing the results should be agreed between the purchaser and the supplier, and should be taken from any options permitted in the International Standard method of test if one exists. In either case, the chosen test conditions shall be recorded.

3.4.3.2 The second suffix number indicates the temperature of test and should be taken from table 7.

If three or more digits are required to specify the test conditions, the method of test and temperature elements shall be separated by a dash, for example A1-10, C10-0.

3.4.4 Example of designation for additional properties using suffix letters and suffix numbers

The code A14 defines :

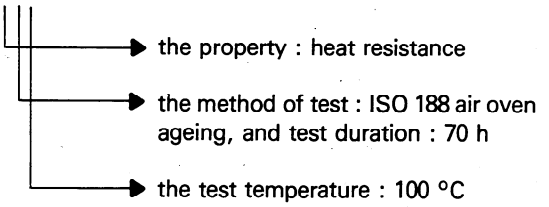


Table 6 — First suffix numbers to designate methods of test and test conditions

Suffix letter (see table 5)	Property	First suffix number									
		1	2	3	4	5	6	7	8	9	10
		Method of test and test conditions									
A	Air oven ageing	ISO 188, 70 h	ISO 188, 7 days	ISO 188, 14 days	ISO 188, 28 days	ISO 188, 42 days					
B	Compression set	ISO 815, 22 h	ISO 815, 70 h	ISO 815, 7 days	ISO 815, 14 days	ISO 815, 28 days					
	Tension set under constant elongation						ISO 2285				
	Tension set after constant load							See note 1			
C	Ozone resistance under static conditions (threshold strain)	ISO 1431/1, 50 pphm (see note 2)	ISO 1431/1, 25 pphm	ISO 1431/1, 100 pphm	ISO 1431/1, 200 pphm						
	Ozone resistance under dynamic conditions					ISO 1431/2, 50 pphm	ISO 1431/2, 25 pphm	ISO 1431/2, 100 pphm	ISO 1431/2, 200 pphm		
	Weather resistance									See note 1	
	Light ageing										See note 1

Table 6 (*continued*)

Suffix letter (see table 5)	Property	First suffix number									
		1	2	3	4	5	6	7	8	9	10
		Method of test and test conditions									
D	Stress relaxation in compression	ISO 3384									
	Creep		See note 1								
E	Resistance to liquids	ISO 1817, volumetric method									
EO	Oil resistance	Oil No. 1, 70 h	Oil No. 2, 70 h	Oil No. 3, 70 h	Oil No. 1, 7 days	Oil No. 2, 7 days	Oil No. 3, 7 days	Liquid No. 101, 70 h			
EF	Resistance to hydrocarbon liquids	Liquid A, 70 h	Liquid B, 70 h	Liquid C, 70 h							
EA	Aqueous fluid resistance	Distilled water, 70 h	Distilled water, 7 days	Distilled water and ethylene-glycol, 1:1 (*V*/*V*), 70 h							
F	Brittleness temperature	ISO/R 812									
	Torsional modulus (Gehman test)		ISO 1432, T_2	ISO 1432, T_{10}	ISO 1432, max. 70 MPa						
	Compression set					ISO 1653, 22 h					
	Hardness increase						ISO 3387 ISO 48				
	Temperature-retraction (TR) test							ISO 2921, TR10	ISO 2921, TR30	ISO 2921, TR50	ISO 2921, TR70
G	Tear strength	ISO 34, crescent	ISO 34, angle	ISO 34, trouser							
	Tear strength (Delft)				ISO 816						
H	Resistance to flex cracking (De Mattia)	ISO 132									
	Resistance to crack growth (De Mattia)		ISO 133								
	Tension fatigue			See note 3							
J	Abrasion resistance	ISO 4649									
K	Rubber to metal adhesion (two-plate method)	ISO 814									
	Rubber to metal adhesion (one-plate method)		ISO 813								
	Adhesion of rubber to rigid plates in shear (quadruple shear test)			ISO 1747							
	Rubber to textile adhesion				ISO/R 36						
L	Impermeability to gases — Constant volume method	ISO 1399									
	Impermeability to gases — Constant pressure method		ISO 2782								
M	Flammability resistance	See note 1									
N	Chemical resistance	ISO 1817									
		Hydrochloric acid		Sulphuric acid		Nitric acid		Sodium hydroxide		Sodium hypochlorite	
		10 % solution	37 % solution	3 % solution	30 % solution	10 % solution	40 % solution	10 % solution	60 % solution	10 % solution	
O	Electrical resistivity	ISO 1853									
	Electrical insulation resistance		ISO 2951								
	Breakdown voltage			See note 1							
P	Staining in contact with organic materials	ISO 3865, Method A1	ISO 3865, Method A2								
	Corrosion of metals			ISO 6505							

Table 6 (*concluded*)

Suffix letter (see table 5)	Property	First suffix number									
		1	2	3	4	5	6	7	8	9	10
		Method of test and test conditions									
R	Rebound resilience	ISO 4662									
S	Complex shear modulus G^* (Torsion pendulum)	ISO 4663									
	Mechanical loss factor tan δ (Torsion pendulum)		ISO 4663								
	Complex shear modulus G^* (Forced sinusoidal shear strain)			ISO 4664							
	Mechanical loss factor tan δ (Forced sinusoidal shear strain)				ISO 4664						
	Rotary flexometer :	ISO 4666									
	— temperature rise					ISO 4666/1 and ISO 4666/2					
	— resistance to fatigue						ISO 4666/1 and ISO 4666/2				
	Compression flexometer :	ISO 4666									
	— temperature rise							ISO 4666/1 and ISO 4666/3			
	— resistance to fatigue								ISO 4666/1 and ISO 4666/3		
T	Stress at constant elongation	ISO 37									
	Elongation at constant stress		ISO 37								
	Modulus in compression			See note 1							
	Modulus in shear				ISO 1827						
U, V, W, X, Y	(Reserved for new properties)										
Z	Any special requirements which shall be specified in detail										

NOTES

1 A method of test will form the subject of a future International Standard.

2 Ozone concentration (see suffix letter C) may also be expressed in terms of the partial pressure of ozone. At standard conditions of atmospheric pressure and temperature (101 kPa, 273 K), a concentration of 1 pphm is equivalent to a partial pressure of 1,01 mPa.

3 A method of test will form the subject of ISO 6943.