TECHNICAL REPORT

ISO/TR 17051

First edition

Rubber, vulcanized — Guidelines for material specification

Caoutchouc vulcanisé — Lignes directrices pour la spécification des matériaux

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This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

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Introduction

The specifications in this document give good basic materials for general use. For specific product applications, materials with modified specifications can be needed. There can also be a need to specify additional tests such as for dynamic properties.

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Rubber, vulcanized — Guidelines for material specification

1 Scope

This document establishes guidelines for the specification of vulcanized rubber based on the properties of individual rubber types. This document helps users of rubber products, who are not rubber experts, to create a specification for the rubber materials they wish to use.

It also describes a designation system to enable a line call-cut code to be devised for each specification.

Since the properties of rubber depend on the type of rubber, such as composition, some rubbers are classified into several types and organized by hardness.

Representative specifications for the following rubber types are given in Annexes B to M: natural rubber (NR), styrene butadiene rubber (SBR), nitrile rubber (NBR), hydrogenated nitrile rubber (HNBR), nitrile rubber mixed with PVC (NBR/PVC), chloroprene rubber (CR), ethylene acrylic rubber (AEM), fluorocarbon rubber (FKM), silicone rubber (VMQ), epichlorohydrin rubber (ECO) and ethylene propylene rubber (EPM and EPDM).

In cases of mixed rubber polymers, the main polymer in the rubber material gives the name of the rubber type.

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2 Normative references

ISO 1629, *Rubber and latices — Nomenclature*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1629 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Designing a material specification

For each rubber polymer described in Annex A there are two or more alternative specifications given in Annexes B to M.

When using this document, it is recommended to start by selecting rubber polymer according to ISO/TR 7620, and then select hardness.

In several cases, there are also supplementary properties which can be added to the material specification given in the annexes for the material specifications.

The designation of the selected material is described in Clause 5.

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5 Designation system

The vulcanized rubber material can be designated by the number of this document, i.e. ISO/TR 17051, followed by the rubber type, hardness, type and designation(s) for supplementary properties.

Supplementary properties:

— C = Cold-resistant;

— F = Fuel resistance;

— L = Long-term properties;

— O = Oil resistance;

— Oz = Ozone resistance;

— T = Tear resistance.

EXAMPLE ISO/TR 17051 NR 70-1-C-L.

All materials have certain obligatory properties to be fulfilled by the material. For certain materials, the specification can be made more stringent by supplementary properties. Table 1 lists the supplementary properties possible for various materials.

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Table 1 — Supplementary properties for different materials

Material	Supplementary designation					
	C	F	L	O	Oz	T
Natural rubber (NR) type 1	X		X		X	
Natural rubber (NR) type 2	X		X		X	
Natural rubber (NR) type 3						
Natural rubber (NR) type 4						
Styrene butadien rubber (SBR) type 1	X		X		X	
Styrene butadien rubber (SBR) type 2	X		X		X	
Nitrile rubber (NBR) acrylic content 33 % type 1		X			X	
Nitrile rubber (NBR) acrylic content 28 % type 2					X	
Nitrile rubber (NBR) acrylic content 33 % type 3		X			X	
Nitrile rubber (NBR) acrylic content 28 % type 4					X	
Hydrogenated nitrile rubber (HNBR) type 1						
Hydrogenated nitrile rubber (HNBR) type 2						
Hydrogenated nitrile rubber (HNBR) type 3						
Nitrile/PVC rubber (NBR/PVC) type 1						
Nitrile/PVC Rubber (NBR/PVC) type 2						
Chloroprene rubber (CR) type 1	X					
Chloroprene rubber (CR) type 2						
Acrylic rubber (ACM) type 1						
Acrylic rubber (ACM) type 2						
Ethylene acrylic rubber (AEM) type 1						
Ethylene acrylic rubber (AEM) type 2						
Ethylene acrylic rubber (AEM) type 3						

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Table 1 *(continued)*

Material	Supplementary designation					
	C	F	L	O	Oz	T
Ethylene acrylic rubber (AEM) type 4						
Fluorocarbon rubber copolymer (FKM) type 1						
Fluorocarbon rubber terpolymer (FKM) type 2						
Silicone rubber (VMQ) type 1				X		X
Silicone rubber (VMQ) type 2				X		
Epichlorhydrin rubber (ECO) type 1						
Epichlorhydrin rubber (ECO) type 2						
Ethylene propylene rubber sulfur vulcanised (EPDM)	X					
Ethylene propylene rubber sulfur vulcanised (EPDM)	X					
Ethylene propylene rubber peroxide vulcanised (EPM and EPDM)	X					
Ethylene propylene rubber peroxide vulcanised (EPM and EPDM)	X					

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Annex A
(informative)

Material description

A.1 Natural rubber (NR)

NR has good tensile strength and good wear properties, even without reinforcing fillers. This makes it possible to manufacture soft rubber products with good mechanical properties. For manufacturing of complex products the good processability is an advantage. The low temperature properties are good and the mechanical damping is very low. The oil and ozone resistance is poor. Specifications are given in Annex B.

A.2 Styrene-butadiene rubber (SBR)

SBR requires reinforcing fillers to achieve good mechanical properties. Compared with natural rubber the SBR has higher mechanical damping and not so good low temperature properties. The wear properties are often better than natural rubber when used in tyres at high temperature and high speed. The oil and ozone resistances are poor. Specifications are given in Annex C.

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A.3 Ethylene-propylene rubber (EPM, EPDM)

Ethylene propylene rubber is fully resistant to ozone attack, due to the saturated chemical backbone structure and has also very good heat resistance and good resistance against many chemicals. The EPDM can be extended with high amounts of fillers and softeners. Special care should be taken to achieve good adhesion to textile and metal. Oil resistance is poor. Specifications are given in Annex M.

A.4 Chloroprene rubber (CR)

The ozone resistance of CR is better than the ozone resistance of natural- styrene- and nitrile rubber, but not as good as EPDM. The oil resistance of chloroprene rubber is better than the oil resistance of natural or styrene butadiene rubber, but not as good as nitrile rubber. As CR contains chlorine it does not burn too easily. Specifications are given in Annex G.

A.5 Nitrile rubber (NBR)

NBR has good resistance against oils and fuels are needed. With increased content of acrylonitrile (ACN) the low temperature properties are reduced, while the volume swell in oil and fuel is improved. Heat resistance is good, when the rubber is suitable compounded, but the ozone resistance is poor. Specifications are given in Annex D.

A.6 Hydrogenated nitrile rubber (HNBR)

HNBR has the same resistance against oils and fuels as normal NBR but has an improved high temperature and ozone resistance. Specifications are given in Annex E.

A.7 Nitrile rubber mixed with PVC, NBR/PVC

Nitrile rubber mixed with PVC has an improved ozone resistance over normal nitrile rubber. Specifications are given in Annex F.

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A.8 Silicone rubber (VMQ)

VMQ can be used at both very high and very low temperatures and is ozone resistant. The disadvantages are poor mechanical properties, poor oil resistance and it is sensitive for hydrolysis at higher temperatures and in small closed environments. Specifications are given in Annex K.

A.9 Fluorocarbon rubber (FKM)

FKM has the best resistance against oils and fuels, can be used at very high temperatures and is ozone resistant. The disadvantage is mainly the high price, difficulty to process and limited low temperature properties. As fluorocarbon rubber contains fluorine it does not burn very well. Specifications are given in Annex J.

A.10 Acrylic rubber (ACM)

Acrylic rubber is used primarily in applications where a combined resistance to heat, oils and oil additives are required e.g. O-rings, lip seals and gaskets. The disadvantages are the limited low temperature properties and limited water resistance. Specifications are given in Annex H.

A.11 Ethylene acrylic rubber (AEM)

AEM has a good combination of high resistance against heat and oil, together with rather good low temperature properties. Specifications are given in Annex I.

A.12 Epichloro hydrin rubber, ECO

ECO has good heat resistance combined with very good oil resistance. It shows also low gas permeability together with high rebound resilience. Specifications are given in Annex L.

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Annex B
(informative)

Rubber specification — Natural rubber (NR)

Table B.1 — Basic properties — NR type 1
(natural rubber with high tensile properties and good compression set properties)

Property			Hardness and type number					Test method
			40–1	50–1	60–1	70–1	80–1	(see Bibliography)
Hardness	IRHD	±5	40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min	17	20	20	20	19	ISO 37
Elongation at break	%	Min	550	500	450	350	250	ISO 37
Tension set 70 °C/24 h and 50 % strain	%	Max	25	25	25	30	30	ISO 2285:2019, method A
Tear resistance	N/mm	Min	40	45	50	50	50	ISO 34-1:2010, method C
Compression set 70 °C/24 h	%	Max	25	25	25	30	30	ISO 815-1:2019[a], test pieces type A
Change in hardness 70 °C/72 h	IRHD	Max	±5	±5	±5	±5	±5	ISO 48-2[a]
Change in tensile strength 70 °C/72 h	%	Max	−20	−20	−20	−20	−20	ISO 37[a]
Change in elongation at break 70 °C/72 h	%	Max	−30	−30	−30	−30	−30	ISO 37[a]
Ozone resistance 50 pphm/40 °C/96 h	%	Min	30	30	30	30	30	ISO 1431-1:2012, procedure C

[a] Ageing in accordance with ISO 188:2011, method A.

Table B.2 — Supplementary properties — NR type 1

Property				Hardness and type number					Test method
				40–1	50–1	60–1	70–1	80–1	(see Bibliography)
Long-term (L)	Compression set 70 °C/42 days	%	Max	50	50	50	60	60	ISO 815-1:2019[a], test pieces type A
	Change in hardness 70 °C/42 days	IRHD	Max	+10 −5	+10 −5	+10 −5	++10 −5	+10 −5	ISO 48-2[a]
	Change in tensile strength 70 °C/42 days	%	Max	−40	−40	−40	−40	−40	ISO 37[a]
	Change in elongation at break 70 °C/42 days	%	Max	−55	−55	−55	−55	−55	ISO 37[a]
Cold-resistant (C)	Temp. retraction TR_{10}	°C	Max	−45	−45	−40	−40	−35	ISO 2921
	Temp. retraction TR_{30}	°C	Max	−40	−40	−35	−30	−25	ISO 2921

[a] Ageing in accordance with ISO 188:2011, method A.

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