
Rubber, vulcanized — Guidelines for material specification

Caoutchouc vulcanisé — Lignes directrices pour la spécification des matériaux

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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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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.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 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](#).

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.

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						

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					

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](#).

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](#).

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](#).

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 (see Bibliography)
			40–1	50–1	60–1	70–1	80–1	
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 34-1:2015, 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 (see Bibliography)
				40–1	50–1	60–1	70–1	80–1	
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.

Table B.3 — Basic properties — NR type 2
(natural rubber with moderate tensile properties and moderate compression set properties)

Property			Hardness and type number					Test method (see Bibliography)
			40-2	50-2	60-2	70-2	80-2	
Hardness	IRHD	±5	40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min	12	14	14	14	12	ISO 37
Elongation at break	%	Min	400	400	400	300	200	ISO 37
Tension set 70 °C/24 h and 50 % strain	%	Max	50	50	50	50	50	ISO 2285:2019, method A
Tear resistance	N/mm	Min	30	30	30	40	40	ISO 34-1:2015, method C
Compression set 70 °C/24 h	%	Max	40	40	40	40	40	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 70 °C/72 h	IRHD	Max	+10 -5	+10 -5	+10 -5	+10 -5	+10 -5	ISO 48-2 ^a
Change in tensile strength 70 °C/72 h	%	Max	-25	-25	-25	-25	-25	ISO 37 ^a
Change in elongation at break 70 °C/72 h	%	Max	-35	-35	-35	-35	-35	ISO 37 ^a

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

Table B.4 — Supplementary properties — Type 2

Property				Hardness and type number					Test method (see Bibliography)
				40-2	50-2	60-2	70-2	80-2	
Long-term (L)	Compression set 70 °C/42 days	%	Max	70	70	70	80	80	ISO 815-1:2019 ^a , test pieces type A
	Change in hardness 70 °C/42 days	IRHD	Max	+15 -5	+15 -5	+15 -5	+15 -5	+15 -5	ISO 48-2 ^a
	Change in tensile strength 70 °C/42 days	%	Max	-45	-45	-45	-45	-45	ISO 37 ^a
	Change in elongation at break 70 °C/42 days	%	Max	-65	-65	-65	-65	-65	ISO 37 ^a
Cold-resistant (C)	Temp. retraction TR ₁₀	°C	Max	-40	-40	-35	-35	-30	ISO 2921
	Temp. retraction TR ₃₀	°C	Max	-35	-35	-30	-25	-20	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h		%	Min	20	20	20	20	10	ISO 1431-1:2012, procedure C

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

Table B.5 — Basic properties — NR type 3

Property			Hardness and type number					Test method (see Bibliography)
			40-3	50-3	60-3	70-3	80-3	
Hardness	IRHD	—	40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min	17	20	20	20	17	ISO 37
Elongation at break	%	Min	500	450	400	350	200	ISO 37
Compression set 70 °C/24 h	%	Max	30	30	30	30	30	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 70 °C/72 h	IRHD	Max	+10 -5	+10 -5	+10 -5	+10 -5	+10 -5	ISO 48-2 ^a
Change in tensile strength 70 °C/72 h	%	Max	-25	-25	-25	-25	-25	ISO 37 ^a
Change in elongation at break 70 °C/72 h	%	Max	-35	-35	-35	-35	-35	ISO 37 ^a
Ozone resistance 50 pphm/40 °C/96 h	%	Min	20	20	20	20	10	ISO 1431-1:2012, procedure C

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

Table B.6 — Basic properties — NR type 4

Property			Hardness and type number					Test method (see Bibliography)
			40-4	50-4	60-4	70-4	80-4	
Hardness	IRHD	—	40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min	7	10	10	10	7	ISO 37
Elongation at break	%	Min	400	400	350	250	100	ISO 37
Compression set 70 °C/24 h	%	Max	50	50	50	50	50	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 70 °C/72 h	IRHD	Max	+15 -5	+15 -5	+15 -5	+15 -5	+15 -5	ISO 48-2 ^a
Change in tensile strength 70 °C/72 h	%	Max	-30	-30	-30	-30	-30	ISO 37 ^a
Change in elongation at break 70 °C/72 h	%	Max	-40	-40	-40	-40	-40	ISO 37 ^a
Ozone resistance 50 pphm/40 °C/96 h	%	Min	20	20	20	20	10	ISO 1431-1:2012, procedure C

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

Annex C

(informative)

Rubber specification — Styrene-butadiene rubber (SBR)

Table C.1 — Basic properties — SBR type 1
(styrene-butadiene rubber with high tensile properties and good compression set properties)

Property				Hardness and type number					Test method (see Bibliography)
				40-1	50-1	60-1	70-1	80-1	
Hardness	IRHD	±5		40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min		12	14	14	14	12	ISO 37
Elongation at break	%	Min		500	450	400	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		30	40	40	40	40	ISO 34-1:2015, 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 C.2 — Supplementary properties — SBR type 1

Property				Hardness and type number					Test method (see Bibliography)
				40-1	50-1	60-1	70-1	80-1	
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	+10	+10	+10	+10	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	-40	-40	-35	-35	-30	ISO 2921
	Temp. retraction TR ₃₀	°C	Max	-35	-35	-30	-25	-20	ISO 2921

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

Table C.3 — Basic properties — SBR type 2
(styrene-butadiene rubber with moderate tensile properties and moderate compression set properties)

Property			Hardness and type number					Test method (see Bibliography)
			40-2	50-2	60-2	70-2	80-2	
Hardness	IRHD	±5	40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min	7	10	10	10	7	ISO 37
Elongation at break	%	Min	400	400	400	300	200	ISO 37
Tension set 70 °C/24 h and 50 % strain	%	Max	50	50	50	50	50	ISO 2285:2019, method A
Tear resistance	N/mm	Min	25	35	35	35	35	ISO 34-1:2015, method C
Compression set 70 °C/24 h	%	Max	50	50	50	50	50	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	-25	-25	-25	-25	-25	ISO 37 ^a
Change in elongation at break 70 °C/72 h	%	Max	-35	-35	-35	-35	-35	ISO 37 ^a

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

Table C.4 — Supplementary properties — Type 2

Property				Hardness and type number					Test method (see Bibliography)
				40-2	50-2	60-2	70-2	80-2	
Long-term (L)	Compression set 70 °C/42 days	%	Max	70	70	70	80	80	ISO 815-1:2019 ^a , test pieces type A
	Change in hardness 70 °C/42 days	IRHD	Max	+15	+15	+15	+15	+15	ISO 48-2 ^a
	Change in tensile strength 70 °C/42 days	%	Max	-45	-45	-45	-45	-45	ISO 37 ^a
	Change in elongation at break 70 °C/42 days	%	Max	-65	-65	-65	-65	-65	ISO 37 ^a
Cold-resistant (C)	Temp. retraction TR ₁₀	°C	Max	-40	-40	-35	-35	-30	ISO 2921
	Temp. retraction TR ₃₀	°C	Max	-35	-35	-30	-25	-20	ISO 2921
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.

Annex D (informative)

Rubber specification — Nitrile rubber (NBR)

Table D.1 — Basic properties — NBR type 1 (33 % acrylnitrile content)

Property				Hardness and type number					Test method (see Bibliography)
				40-1	50-1	60-1	70-1	80-1	
Hardness	IRHD	±5	40	50	60	70	80		ISO 48-2
Tensile strength	MPa	Min	7	7	10	10	10	10	ISO 37
Elongation at break	%	Min	400	350	300	250	200		ISO 37
Tension set 100 °C/24 h and 50 % strain	%	Max	25	25	25	25	25		ISO 2285:2019, method A
Tear resistance	N/mm	Min	15	20	20	20	20		ISO 34-1:2015, method C
Compression set 100 °C/24 h 100 °C/42 days	%	Max	25	25	25	25	25		ISO 815-1:2019 ^a , test pieces type A
	%	Max	50	50	50	50	50		
Change in hardness 100 °C/72 h 100 °C/42 days	IRHD	Max	+10	+10	+10	+10	+5		ISO 48-2 ^a
	IRHD	Max	+25	+25	+15	+15	+10		
Change in tensile strength 100 °C/72 h 100 °C/42 days	%	Max	-20	-20	-20	-20	-20		ISO 37 ^a
	%	Max	-20	-20	-20	-20	-20		
Change in elongation at break 100 °C/72 h 100 °C/42 days	%	Max	-30	-30	-30	-30	-30		ISO 37 ^a
	%	Max	-65	-65	-65	-65	-65		
Temp. retraction TR ₁₀	°C	Max	-30	-25	-25	-25	-25		ISO 2921
Temp. retraction TR ₃₀	°C	Max	-25	-20	-20	-20	-20		ISO 2921
Resistance to liquids 100 °C/72 h	Oil No 1	%	Max	+5 -15	+5 -10	+5 -10	+5 -10	+5 -10	ISO 1817
	Oil No 3	%	Max	+20 -5	+10 -5	+10 -5	+10 -5	+10 -5	

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

Table D.2 — Supplementary properties — NBR type 1

Property				Hardness and type number					Test method (see Bibliography)
				40-1	50-1	60-1	70-1	80-1	
Ozone resistance (Oz)	Ozone resistance 50 pphm/40 °C/96 h	°C	Max	20	20	20	15	10	ISO 1431-1:2012, procedure C
Fuel resistance (F)	Resistance to liquids 23 °C/72 h (Change in volume)	Liquid C (fuel)	%	Max	+65 0	+65 0	+50 0	+50 0	ISO 1817

Table D.3 — Basic properties — NBR type 2 (28 % acrylonitrile content)

Property:			Hardness and type number					Test method: (see Bibliography)
			40-2	50-2	60-2	70-2	80-2	
Hardness	IRHD	±5	40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min	7	7	10	10	10	ISO 37
Elongation at break	%	Min	400	350	300	250	200	ISO 37
Tension set 100 °C/24 h and 50 % strain	%	Max	20	20	20	20	20	ISO 2285:2019, method A
Tear resistance	N/mm	Min	15	20	20	20	20	ISO 34-1:2015, method C
Compression set 100 °C/24 h 100 °C/42 days	%	Max	20	20	20	20	20	ISO 815-1:2019 ^a , test pieces type A
	%	Max	50	50	50	50	50	
Change in hardness 100 °C/72 h 100 °C/42 days	IRHD	Max	+10	+10	+10	+10	+10	ISO 48-2 ^a
	IRHD	Max	+25	+25	+25	+25	+25	
Change in tensile strength 100 °C/72 h 100 °C/42 days	%	Max	-20	-20	-20	-20	-20	ISO 37 ^a
	%	Max	-20	-20	-20	-20	-20	
Change in elongation at break 100 °C/72 h 100 °C/42 days	%	Max	-30	-30	-30	-30	-30	ISO 37 ^a
	%	Max	-65	-65	-65	-65	-65	
Temp. retraction TR ₁₀	°C	Max	-40	-40	-35	-35	-35	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-35	-35	-30	-30	-30	ISO 2921
Resistance to liquids 100 °C/72 h (Change in volume)	Oil No 1	%	Max	+5 -15	+5 -15	+5 -15	+5 -15	ISO 1817
	Oil No 3	%	Max	+25 0	+25 0	+25 0	+25 0	ISO 1817

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

Table D.4 — Supplementary properties — NBR type 2

Property				Hardness and type number					Test method (see Bibliography)
				40-2	50-2	60-2	70-2	80-2	
Ozone resistance (Oz)	Ozone resistance 50 pphm/40 °C/96 h	°C	Max	20	20	20	15	10	ISO 1431-1:2012, procedure C

Table D.5 — Basic properties — NBR type 3
(33 % acrylnitrile content without long-term properties and with moderate properties)

Property				Hardness and type number					Test method (see Bibliography)
				40-3	50-3	60-3	70-3	80-3	
Hardness	IRHD	—		40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min		7	7	10	10	10	ISO 37
Elongation at break	%	Min		400	350	300	250	150	ISO 37
Compression set 100 °C/24 h	%	Max		50	50	50	50	50	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 100 °C/72 h	IRHD	Max		+15	+15	+15	+15	+15	ISO 48-2 ^a
Change in tensile strength 100 °C/72 h	%	Max		-30	-30	-30	-30	-30	ISO 37 ^a
Change in elongation at break 100 °C/72 h	%	Max		-40	-40	-40	-40	-40	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max		-30	-25	-25	-25	-25	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-25	-20	-20	-20	-20	ISO 2921
Resistance to liquids 100 °C/72 h (Change in volume)	Oil No 1	%	Max	+10 -15	+10 -10	+10 -10	+10 -10	+10 -10	ISO 1817
	Oil No 3	%	Max	+25 -5	+20 -5	+20 -5	+20 -5	+20 -5	

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

Table D.6 — Supplementary properties — NBR type 3

Property				Hardness and type number					Test method (see Bibliography)
				40-3	50-3	60-3	70-3	80-3	
Ozone resistance (Oz)	Ozone resistance 50 pphm/40 °C/96 h	°C	Max	20	20	20	15	10	ISO 1431-1:2012, procedure C
Fuel resistance (F)	Resistance to liquids 23 °C/72 h (Change in volume)	Liquid C (fuel)	%	Max	+65 0	+65 0	+50 0	+50 0	ISO 1817

Table D.7 — Basic properties — NBR type 4
(ca. 28 % acrylnitrile content, no long-term properties and with moderate properties)

Property				Hardness and type number					Test method (see Bibliography)
				40-4	50-4	60-4	70-4	80-4	
Hardness	IRHD	—		40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min		7	7	10	10	10	ISO 37
Elongation at break	%	Min		400	350	300	250	150	ISO 37
Compression set 100 °C/24 h	%	Max		30	30	30	30	30	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 100 °C/72 h	IRHD	Max		+15	+15	+15	+15	+15	ISO 48-2 ^a
Change in tensile strength 100 °C/72 h	%	Max		-30	-30	-30	-30	-30	ISO 37 ^a
Change in elongation at break 100 °C/72 h	%	Max		-40	-40	-40	-40	-40	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max		-40	-45	-35	-35	-35	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-35	-35	-30	-30	-30	ISO 2921
Resistance to liquids 100 °C/72 h (Change in volume)	Oil No 1	%	Max	+10 -15	+10 -15	+10 -15	+10 -15	+10 -15	ISO 1817
	Oil No 3	%	Max	+60 -0	+60 -0	+60 -0	+60 -0	+60 -0	ISO 1817

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

Table D.8 — Supplementary properties — NBR type 4

Property				Hardness and type number					Test method (see Bibliography)
				40-4	50-4	60-4	70-4	80-4	
Ozone resistance (Oz)	Ozone resistance 50 pphm/40 °C/96 h	°C	Max	20	20	20	15	10	ISO 1431-1:2012, procedure C

Annex E

(informative)

Rubber specification — Hydrogenated nitrile rubber (HNBR)

Table E.1 — Basic properties — HNBR type 1
(materials with high degree of hydrogenation)

Property				Hardness and type number				Test method (see Bibliography)
				50-1	60-1	70-1	80-1	
Hardness	IRHD	±5		50	60	70	80	ISO 48-2
Tensile strength	MPa	Min		15	18	20	20	ISO 37
Elongation at break	%	Min		500	350	250	150	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max		30	30	30	35	ISO 2285:2019, method A
Tear resistance	N/mm	Min		15	20	25	35	ISO 34-1:2015, method C
Compression set 150 °C/24 h 150 °C/42 days	%	Max		30	30	30	35	ISO 815-1:2019 ^a , test pieces type A
	%	Max		60	60	60	70	
Change in hardness 150 °C/72 h 150 °C/42 days	IRHD	Max		+10	+5	+5	+5	ISO 48-2 ^a
	IRHD	Max		+20	+15	+15	+15	
Change in tensile strength 150 °C/72 h 150 °C/42 days	%	Max		-15	-15	-15	-15	ISO 37 ^a
	%	Max		-25	-25	-25	-25	
Change in elongation at break 150 °C/72 h 150 °C/42 days	%	Max		-30	-30	-30	-30	ISO 37 ^a
	%	Max		-70	-70	-70	-70	
Temp. retraction TR ₁₀	°C	Max		-15	-15	-15	-15	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-10	-10	-10	-8	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min		80	80	60	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max	+5 -1	+5 -1	+5 -1	+5 -1	ISO 1817
	Oil No 3	%	Max	+30 0	+30 0	+30 0	+30 0	ISO 1817

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

Table E.2 — Basic properties — HNBR type 2
(materials with moderate degree of hydrogenation)

Property			Hardness and type number				Test method (see Bibliography)
			50-2	60-2	70-2	80-2	
Hardness	IRHD	±5	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min	12	12	12	12	ISO 37
Elongation at break	%	Min	400	300	200	150	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max	30	30	30	35	ISO 2285:2019, method A
Tear resistance	N/mm	Min	10	15	20	25	ISO 34-1:2015, method C
Compression set 150 °C/24 h 150 °C/42 days	%	Max	25	25	25	30	ISO 815-1:2019 ^a , test pieces type A
	%	Max	50	50	50	60	
Change in hardness 150 °C/72 h 150 °C/42 days	IRHD	Max	+10	+5	+5	+5	ISO 48-2 ^a
	IRHD	Max	+20	+15	+15	+15	
Change in tensile strength 150 °C/72 h 150 °C/42 days	%	Max	-20	-20	-20	-20	ISO 37 ^a
	%	Max	-35	-35	-35	-35	
Change in elongation at break 150 °C/72 h 150 °C/42 days	%	Max	-30	-30	-30	-30	ISO 37 ^a
	%	Max	-75	-75	-75	-75	
Temp. retraction TR ₁₀	°C	Max	-25	-25	-25	-25	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-20	-20	-20	-20	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min	80	80	60	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max	±5	±5	±5	ISO 1817
	Oil No 3	%	Max	+30 0	+30 0	+30 0	ISO 1817

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

Table E.3 — Basic properties — HNBR type 3

(materials with moderate degree of hydrogenation, without long-term properties and with moderate properties)

Property			Hardness and type number				Test method (see Bibliography)
			50-3	60-3	70-3	80-3	
Hardness	IRHD	—	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min	12	12	12	12	ISO 37
Elongation at break	%	Min	400	300	200	150	ISO 37
Compression set 125 °C/24 h	%	Max	25	25	25	30	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 150 °C/72 h	IRHD	Max	+10	+10	+10	+10	ISO 48-2 ^a
Change in tensile strength 150 °C/72 h	%	Max	-25	-25	-25	-25	ISO 37 ^a
Change in elongation at break 150 °C/72 h	%	Max	-35	-35	-35	-35	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max	-25	-25	-25	-25	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-20	-20	-20	-20	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min	80	80	60	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h	Oil No 1	%	Max	+5 -10	+5 -10	+5 -10	ISO 1817
(Change in volume)	Oil No 3	%	Max	+30 -0	+30 -0	+30 -0	ISO 1817

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

Annex F (informative)

Rubber specification — Nitrile rubber with PVC (NBR/PVC)

Table F.1 — Basic properties — NBR/PVC type 1

Property				Hardness and type number			Test method (see Bibliography)
				50-1	60-1	70-1	
Hardness	IRHD	±5		50	60	70	ISO 48-2
Tensile strength	Mpa	Min		10	10	10	ISO 37
Elongation at break	%	Min		300	250	200	ISO 37
Tension set 100 °C/24 h and 50 % strain	%	Max		40	40	40	ISO 2285:2019, method A
Tear resistance	N/mm	Min		20	25	30	ISO 34-1:2015, method C
Compression set 100 °C/24 h 100 °C/42 days	%	Max		40	40	40	ISO 815-1:2019 ^a , test pieces type A
	%	Max		60	60	60	
Change in hardness 100 °C/72 h 100 °C/42 days	IRHD	Max		+10	+10	+10	ISO 48-2 ^a
	IRHD	Max		+15	+15	+15	
Change in tensile strength 100 °C/72 h 100 °C/42 days	%	Max		-20	-20	-20	ISO 37 ^a
	%	Max		-25	-25	-25	
Change in elongation at break 100 °C/72 h 100 °C/42 days	%	Max		-40	-40	-40	ISO 37 ^a
	%	Max		-60	-60	-60	
Temp. retraction TR ₁₀	°C	Max		-20	-20	-20	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-15	-15	-10	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min		40	40	30	ISO 1431-1:2012, procedure C
Resistance to liquids 100 °C/72 h	Oil No 1	%	Max	0 -20	0 -20	0 -20	ISO 1817
(Change in volume)	Oil No 3	%	Max	+10 -5	+10 -5	+10 -5	ISO 1817
Fuel resistance 23 °C/72 h (Change in volume)	Liquid C (fuel)	%	Max	+35 0	+35 0	+35 0	ISO 1817

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

Table F.2 — Basic properties — NBR/PVC type 2
(no long-term properties and with moderate properties)

Property				Hardness and type number			Test method (see Bibliography)
				50-2	60-2	70-2	
Hardness	IRHD	—		50 ± 5	60 ± 5	70 ± 5	ISO 48-2
Tensile strength	Mpa	Min		10	10	10	ISO 37
Elongation at break	%	Min		250	200	200	ISO 37
Compression set 100 °C/24 h	%	Max		40	40	40	ISO 815-1:2019 ^a , test piece type A
Change in hardness 100 °C/72 h	IRHD	Max		+15	+15	+15	ISO 48-2 ^a
Change in tensile strength 100 °C/72 h	%	Max		-25	-25	-25	ISO 37 ^a
Change in elongation at break 100 °C/72 h	%	Max		-45	-45	-45	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max		-20	-20	-20	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-15	-15	-10	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min		40	40	30	ISO 1431-1:2012, procedure C
Resistance to liquids 100 °C/72 h (Change in volume)	Oil No 1	%	Max	0 -20	0 -20	0 -20	ISO 1817
	Oil No 3	%	Max	+15 -10	+15 -10	+15 -10	
Fuel resistance 23 °C/72 h (Change in volume)	Liquid C (fuel)	%	Max	+40 -0	+40 -0	+40 -0	ISO 1817

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

Annex G (informative)

Rubber specification — Chloroprene rubber (CR)

Table G.1 — Basic properties — CR type 1

Property				Hardness and type number					Test method (see Bibliography)
				40-1	50-1	60-1	70-1	80-1	
Hardness	IRHD	±5		40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min		9	10,5	10,5	10,5	10,5	ISO 37
Elongation at break	%	Min		350	300	250	200	150	ISO 37
Tension set 100 °C/24 h and 50 % strain	%	Max		35	35	35	35	35	ISO 2285:2019, method A
Tear resistance	N/mm	Min		10	15	20	20	20	ISO 34-1:2015, method C
Compression set 100 °C/24 h 100 °C/42 days	%	Max		35	35	35	35	35	ISO 815-1:2019 ^a , test pieces type A
	%	Max		60	60	60	60	60	
Change in hardness 100 °C/72 h 100 °C/42 days	IRHD	Max		+5	+5	+5	+5	+5	ISO 48-2 ^a
	IRHD	Max		+15	+15	+15	+15	+15	
Change in tensile strength 100 °C/72 h 100 °C/42 days	%	Max		-20	-20	-20	-20	-20	ISO 37 ^a
	%	Max		-35	-35	-35	-35	-35	
Change in elongation at break 100 °C/72h 100 °C/42 days	%	Max		-30	-30	-30	-30	-30	ISO 37 ^a
	%	Max		-60	-60	-60	-60	-60	
Temp. retraction TR ₁₀	°C	Max		-30	-30	-30	-25	-20	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-25	-25	-25	-20	-15	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min		60	60	50	50	40	ISO 1431-1:2012, procedure C
Resistance to liquids 100 °C/72 h	Oil No 1	%	Max	+10 -5	+10 -5	+10 -5	+10 -5	+10 -5	ISO 1817
(Change in volume)	Oil No 3	%	Max	+80 0	+80 0	+80 0	+80 0	+80 0	ISO 1817

Table G.2 — Supplementary properties — CR type 1

Property				Hardness and type number					Test method (see Bibliography)
				40-1	50-1	60-1	70-1	80-1	
Cold-resistant (C)	Low temperature compression set -10 °C/72 h ^b	%	Max	30	30	30	50	90	ISO 815-1 ^a

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

^b Change in hardness max 10 IRHD at -10 °C.

Table G.3 — Basic properties CR type 2
(no long-term properties and with moderate properties)

Property				Hardness and type number					Test method (see Bibliography)
				40-2	50-2	60-2	70-2	80-2	
Hardness	IRHD	—		40 ± 5	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min		7	7	7	7	7	ISO 37
Elongation at break	%	Min		350	300	250	200	100	ISO 37
Compression set 100 °C/24 h	%	Max		80	80	80	80	80	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 100 °C/72 h	IRHD	Max		+15	+15	+15	+15	+15	ISO 48-2 ^a
Change in tensile strength 100 °C/72 h	%	Max		-30	-30	-30	-30	-30	ISO 37 ^a
Change in elongation at break 100 °C/72 h	%	Max		-40	-40	-40	-40	-40	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max		-30	-30	-30	-25	-20	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-25	-25	-25	-20	-15	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min		40	40	30	30	20	ISO 1431-1:2012, procedure C
Resistance to liquids 100 °C/72 h (Change in volume)	Oil No 1	%	Max	+10 -15	+10 -15	+10 -15	+10 -15	+10 -15	ISO 1817
	Oil No 3	%	Max	+120 0	+120 0	+120 0	+120 0	+120 0	ISO 1817
^a Ageing in accordance with ISO 188:2011, method A									

Annex H

(informative)

Rubber specification — Acrylic rubber (ACM)

Table H.1 — Basic properties — ACM type 1

Property			Hardness and type number		Test method (see Bibliography)
			70-1	80-1	
Hardness	IRHD	±5	70	80	ISO 48-2
Tensile strength	MPa	Min	9	9	ISO 37
Elongation at break	%	Min	175	125	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max	40	45	ISO 2285:2019, method A
Tear resistance	N/mm	Min	20	20	ISO 34-1:2015, method C
Compression set 150 °C/24 h 150 °C/42 days	%	Max	40	45	ISO 815-1:2019 ^a , test pieces type A
	%	Max	70	75	
Change in hardness 150 °C/72 h 150 °C/42 days	IRHD	Max	+5	+5	ISO 48-2 ^a
	IRHD	Max	+10	+10	
Change in tensile strength 150 °C/72 h 150 °C/42 days	%	Max	-10	-10	ISO 37 ^a
	%	Max	-30	-30	
Change in elongation at break 150 °C/72 h 150 °C/42 days	%	Max	-20	-20	ISO 37 ^a
	%	Max	-60	-60	
Temp. retraction TR ₁₀	°C	Max	-25	-25	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-15	-15	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min	60	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h	Oil No 1	%	±5	±5	ISO 1817
(Change in volume)	Oil No 3	%	+20 0	+20 0	ISO 1817

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

Table H.2 — Basic properties — ACM type 2
(no long-term properties and with moderate properties)

Property			Hardness and type number				Test method (see Bibliography)
			50-2	60-2	70-2	80-2	
Hardness	IRHD	—	50 ± 5	60 ± 5	70 ± 5	80 ± 5	ISO 48-2
Tensile strength	MPa	Min	7	7	7	7	ISO 37
Elongation at break	%	Min	250	200	150	100	ISO 37
Compression set 150 °C/24 h	%	Max	60	60	60	60	ISO 815-1:2019, ^a test pieces type A
Change in hardness 150 °C/72 h	IRHD	Max	+15	+15	+15	+15	ISO 48-2 ^a
Change in tensile strength 125 °C/72 h	%	Max	-30	-30	-30	-30	ISO 37 ^a
Change in elongation at break 150 °C/72 h	%	Max	-40	-40	-40	-40	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max	-10	-10	-10	-10	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-5	-5	-5	-5	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min	80	80	60	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max	+10 -5	+10 -5	+10 -5	ISO 1817
	Oil No 3	%	Max	+60 0	+60 0	+60 0	ISO 1817

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

Annex I (informative)

Rubber specification — Ethylene acrylic rubber (AEM)

Table I.1 — Basic properties — AEM type 1 (moderate swell)

Property			Hardness and type number				Test method (see Bibliography)
			40-1	50-1	60-1	70-1	
Hardness	°Shore A	±5	40	50	60	70	ISO 48-4
Tensile strength	MPa	Min	7	9	10	11	ISO 37
Elongation at break	%	Min	400	350	300	250	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max	15	15	15	15	ISO 2285:2019, method A
Tear resistance	N/mm	Min	15	20	20	20	ISO 34-1:2015, method C
Compression set 150 °C/24 h 150 °C/42 days	%	Max	15	15	15	15	ISO 815-1:2019 ^a , test pieces type A
	%	Max	40	40	40	40	
Change in hardness 150 °C/72 h 150 °C/42 days	°Shore A	Max	+5	+5	+5	+5	ISO 48-4 ^a
	°Shore A	Max	+10	+10	+10	+10	
Change in tensile strength 150 °C/72 h 150 °C/42 days	%	Max	-20	-20	-20	-20	ISO 37 ^a
	%	Max	-20	-20	-20	-20	
Change in elongation at break 150 °C/72 h 150 °C/42 days	%	Max	-20	-20	-20	-20	ISO 37 ^a
	%	Max	-40	-40	-40	-40	
Temp. retraction TR ₁₀	°C	Max	-28	-28	-28	-28	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-20	-20	-20	-20	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min	80	80	80	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h	Oil No 1	%	Max	±5	±5	±5	ISO 1817
(Change in volume)	Oil No 3	%	Max	+60 0	+60 0	+60 0	ISO 1817

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

Table I.2 — Basic properties — AEM type 2 (low swell)

Property			Hardness and type number				Test method (see Bibliography)
			40-2	50-2	60-2	70-2	
Hardness	°Shore A	±5	40	50	60	70	ISO 48-4
Tensile strength	MPa	Min	7	9	10	11	ISO 37
Elongation at break	%	Min	400	350	300	250	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max	15	15	15	15	ISO 2285:2019, method A
Tear resistance	N/mm	Min	15	20	20	20	ISO 34-1:2015, method C
Compression set 150 °C/24 h 150 °C/42 days	%	Max	15	15	15	15	ISO 815-1:2019, ^a test pieces type A
	%	Max	40	40	40	40	
Change in hardness 150 °C/72 h 150 °C/42 days	°Shore A	Max	+5	+5	+5	+5	ISO 48-4 ^a
	°Shore A	Max	+10	+10	+10	+10	
Change in tensile strength 150 °C/72 h 150 °C/42 days	%	Max	-20	-20	-20	-20	ISO 37 ^a
	%	Max	-20	-20	-20	-20	
Change in elongation at break 150 °C/72 h 150 °C/42 days	%	Max	-20	-20	-20	-20	ISO 37 ^a
	%	Max	-40	-40	-40	-40	
Temp. retraction TR ₁₀	°C	Max	-25	-25	-25	-25	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-15	-15	-15	-15	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min	80	80	80	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max +5 -10	+5 -10	+5 -10	+5 -10	ISO 1817
	Oil No 3	%	Max +30 0	+30 0	+30 0	+30 0	ISO 1817

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

Table I.3 — Basic properties — AEM type 3
(moderate swell type without long-term properties and with moderate properties)

Property				Hardness and type number				Test method (see Bibliography)
				40-3	50-3	60-3	70-3	
Hardness	°Shore A			40 ± 5	50 ± 5	60 ± 5	70 ± 5	ISO 48-4
Tensile strength	MPa	Min		7	7	7	7	ISO 37
Elongation at break	%	Min		300	250	200	150	ISO 37
Compression set 150 °C/24 h	%	Max		50	50	50	50	ISO 815-1:2019 ^a , test pieces type A
Change in hardness 150 °C/72 h	°Shore A	Max		+15	+15	+15	+15	ISO 48-4 ^a
Change in tensile strength 150 °C/72 h	%	Max		-40	-40	-40	-40	ISO 37 ^a
Change in elongation at break 125 °C/72 h	%	Max		-45	-45	-45	-45	ISO 37 ^a
Temp. retraction TR ₁₀	°C	Max		-20	-20	-20	-20	ISO 2921
Temp. retraction TR ₃₀	°C	Max		-15	-15	-15	-15	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h	%	Min		80	80	80	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max	+5 -10	+5 -10	+5 -10	+5 -10	ISO 1817
	Oil No 3	%	Max	+80 0	+80 0	+80 0	+80 0	ISO 1817

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

Table I.4 — Basic properties — AEM type 4
(low swell type without long-term properties and with moderate properties)

Property				Hardness and type number				Test method
				40-4	50-4	60-4	70-4	(see Bibliography)
Hardness		°Shore A		40 ± 5	50 ± 5	60 ± 5	70 ± 5	ISO 48-4
Tensile strength		MPa	Min	7	7	7	7	ISO 37
Elongation at break		%	Min	300	250	200	150	ISO 37
Compression set 150 °C/24 h		%	Max	50	50	50	50	ISO 815-1:2019, ^a test pieces type A
Change in hardness 150 °C/72 h		°Shore A	Max	+15	+15	+15	+15	ISO 48-4 ^a
Change in tensile strength 150 °C/72 h		%	Max	-40	-40	-40	-40	ISO 37 ^a
Change in elongation at break 125 °C/72 h		%	Max	-45	-45	-45	-45	ISO 37 ^a
Temp. retraction TR ₁₀		°C	Max	-15	-15	-15	-15	ISO 2921
Temp. retraction TR ₃₀		°C	Max	-10	-10	-10	-10	ISO 2921
Ozone resistance 50 pphm/40 °C/96 h		%	Min	80	80	80	60	ISO 1431-1:2012, procedure C
Resistance to liquids 150 °C/72 h	Oil No 1	%	Max	+5 -10	+5 -10	+5 -10	+5 -10	ISO 1817
	Oil No 3	%	Max	+40 0	+40 0	+40 0	+40 0	
^a Ageing in accordance with ISO 188:2011, method A.								

Annex J (informative)

Rubber specification — Fluorcarbon rubber (FKM)

Table J.1 — Basic properties — FKM type 1 (copolymer)

Property			Hardness and type number			Test method (see Bibliography)
			60-1	70-1	80-1	
Hardness	IRHD	±5	60	70	80	ISO 48-2
Tensile strength	MPa	Min	11	10	10	ISO 37
Elongation at break	%	Min	200	150	150	ISO 37
Tension set 175 °C/24 h and 50 % strain	%	Max	20	20	20	ISO 2285:2019, method A
Tear resistance	N/mm	Min	15	15	15	ISO 34-1:2015, method C
Compression set 175 °C/24 h 175 °C/42 days	%	Max	20	20	20	ISO 815-1:2019 ^a , test pieces type A
	%	Max	50	50	50	
Change in hardness 175 °C/72 h 175 °C/42 days	IRHD	Max	+5	+5	+5	ISO 48-2 ^a
	IRHD	Max	+10	+10	+10	
Change in tensile strength 175 °C/72 h 175 °C/42 days	%	Max	-15	-15	-15	ISO 37 ^a
	%	Max	-15	-15	-15	
Change in elongation at break 175 °C/72 h 175 °C/42 days	%	Max	-10	-10	-10	ISO 37 ^a
	%	Max	-15	-15	-15	
Temp. retraction TR ₁₀	°C	Max	-15	-15	-15	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-10	-10	-10	ISO 2921
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max	+5 0	+5 0	ISO 1817
	Oil No 3	%	Max	+10 -5	+10 -5	ISO 1817
Resistance to liquids 23 °C/72 h (Change in volume)	Liquid C (fuel)	%	Max	+10 0	+10 0	ISO 1817

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

Table J.2 — Basic properties — FKM type 2 (terpolymer)

Property			Hardness and type number		Test method (see Bibliography)
			70-2	80-2	
Hardness	IRHD	±5	70	80	ISO 48-2
Tensile strength	MPa	Min	10	10	ISO 37
Elongation at break	%	Min	200	150	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max	20	20	ISO 2285:2019, method A
Tear resistance	N/mm	Min	20	20	ISO 34-1:2015, method C
Compression set 150 °C/24 h 150 °C/42 days	%	Max	20	20	ISO 815-1:2019, ^a test pieces type A
	%	Max	50	50	
Change in hardness 150 °C/72 h 150 °C/42 days	IRHD	Max	+5	+5	ISO 48-2 ^a
	IRHD	Max	+10	+10	
Change in tensile strength 150 °C/72 h 150 °C/42 days	%	Max	-15	-15	ISO 37 ^a
	%	Max	-15	-15	
Change in elongation at break 150 °C/72 h 150 °C/42 days	%	Max	-10	-10	ISO 37 ^a
	%	Max	-15	-15	
Temp. retraction TR ₁₀	°C	Max	-12	-12	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-8	-8	ISO 2921
Resistance to liquids 150 °C/72 h (Change in volume)	Oil No 1	%	Max	+5 0	ISO 1817
	Oil No 3	%	Max	±5	ISO 1817
Resistance to liquids 23 °C/72 h (Change in volume)	Liquid C (fuel)	%	Max	+10 0	ISO 1817
	Fuel M85		Max	+40 0	ISO 1817

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

Annex K (informative)

Rubber specification — Silicone rubber (VMQ)

Table K.1 — Basic properties — VMQ type 1

Property			Hardness and type number							Test method (see Bibliography)
			20-1	30-1	40-1	50-1	60-1	70-1	80-1	
Hardness	IRHD	±5	20	30	40	50	60	70	80	ISO 48-2
Tensile strength	MPa	Min	5	5	5	5	7	7	7	ISO 37
Elongation at break	%	Min	650	600	500	400	300	200	150	ISO 37
Tension set 150 °C/24 h and 50 % strain	%	Max	15	15	15	15	15	15	15	ISO 2285:2019, method A
Tear resistance	N/mm	Min	10	10	10	10	15	15	10	ISO 34-1:2015, method C
Compression set 150 °C/24 h	%	Max	15	15	15	15	15	15	15	ISO 815-1:2019 ^a , test pieces type A
150 °C/42 days	%	Max	50	50	50	50	50	50	50	
Change in hardness 175 °C/42 days	IRHD	Max	5	5	5	5	5	5	5	ISO 48-2 ^a
Change in tensile strength 150 °C/72 h	%	Max	-20	-20	-20	-20	-20	-20	-20	ISO 37 ^a
150 °C/42 days	%	Max	-20	-20	-20	-20	-20	-20	-20	
Change in elongation at break 150 °C/72 h	%	Max	-30	-30	-30	-30	-30	-30	-30	ISO 37 ^a
150 °C/42 days	%	Max	-35	-35	-35	-35	-35	-35	-35	
Temp. retraction TR ₁₀	°C	Max	-45	-45	-45	-45	-45	-45	-45	ISO 2921
Temp. retraction TR ₃₀	°C	Max	-35	-35	-35	-35	-35	-35	-35	ISO 2921

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

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

Table K.2 — Supplementary properties — VMQ type 1

Property					Hardness and type number							Test method (see Bibliography)
					20-1	30-1	40-1	50-1	60-1	70-1	80-1	
Oil resistance (O)	Resistance to liquids 150 °C/72 h	Oil No 1	%	Max	+100	+100	+100	+100	+100	+100	+100	ISO 1817
	(Change in volume)	Oil No 3	%	Max	+500	+500	+500	+500	+500	+500	+500	
Tear resistance (T)	Tear resistance		N/mm	Min	15	20	30	35	35	35	35	ISO 34-1:2015, method C