TECHNICAL REPORT 8461

Published 1984-10-01

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

Rubber, vulcanized — Classification — Rubber materials

Caoutchouc vulcanisé — Classification — Matériaux caoutchouc

ISO (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.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types :

— type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development requiring wider exposure;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports types 1 and 2 are subject to review within three years of publication, to decide if they can be transformed into International Standards. Technical reports type 3 do not necessarily have to be reviewed until the data they provide is considered no longer valid or useful.

ISO/TR 8461 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products.*

The reasons which led to the decision to publish this document in the form of a technical report type 2 are explained in the Introduction.

0 Introduction

Work on the classification of vulcanized rubber was carried out by Working Group 8 of Technical Committee ISO/TC 45, *Rubber and rubber products*, over many years. This resulted in the circulation in 1980 of ISO/DIS 4632, *Rubber, vulcanized — Classification system.* This large document covered both the classification system and an extensive number of tables of rubber materials.

UDC 678.063.001.33 Ref. No. ISO/TR 8461-1984 (E)

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

Printed in Switzerland

Price based on 46 pages

The comments on DIS 4632 were examined by WG 8 at its 1980 meeting in Dubrovnik. The comment that the document was too complicated for use by industry was accepted and it was resolved by TC 45 that ISO/DIS 4632 be divided into two parts

Part 1: Description of the classification system.

Part 2: Rubber materials.

ISO 4632/1 was published in 1982.

It was agreed that the second part should be issued as a type 2 Technical Report, (TC 45 Resolution 1293) and Working Group 8/TG 2 was formed for the purpose of examining the text of this report. The amended draft was circulated in 1981 and the comments discussed at the 1981 meeting in Boston. Following extensive discussion, many of the comments, including some of those accompanying the United Kingdom disapproval, were taken into account. As a result it was agreed that the second part, as amended by the Task Group and duly edited be submitted to ISO Central Secretariat for issue as a Technical Report. The amendments included a reconsideration by the Czechoslovak, Swedish, United Kingdom and USA national bodies of the standard vulcanizates submitted by them in the light of comments received.

The reasons for publication as a Technical Report are as follows:

a) the list of rubber materials is complex and extensive. It has already been simplified and it is hoped that during the next 3 years further steps can be taken to eliminate little used grades and combine grades having similar properties;

b) table 1 contains materials submitted by Czechoslovakia, Sweden and USA only. It is necessary to ensure that the list of materials represents those required in all national standards;

c) table 1 does not include materials described in documents under the jurisdiction of ISO/TC 45. Consequently WG 8/TG 2 will seek out such materials and solicit further national rubber materials to be included in the proper format for the intended transformation of ISO/TR 8461 into ISO 4632/2.

1 Scope and field of application

This Technical Report contains the list of properties of rubber materials submitted by member bodies of ISO/TC 45. They are classified and designated by the methods described in ISO 4632/1.

NOTE — The tests employed in this system have been chosen for their reproducibility and ability to control the properties of elastomeric materials. They are not intended to simulate service tests which, because of variability in test conditions, may be unsatisfactory for control purposes. It is recommended that the selection of a rubber material for a given application should be discussed between the user and the supplier so that all relevant operating factors may be considered.

2 References

ISO 1433, *Rubber, vulcanized — Preferred gradation of properties.*

ISO 1629, *Rubbers and latices — Nomenclature.*

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

3 Outline

3.1 Sources and classification

3.1.1 The properties of certain commercially available solid vulcanized rubber materials based upon various national standards are listed in table 1. These materials are intended to cover the majority of applications. The sources of the standards are indicated in table 1 under the following code:

CS Czechoslovakia

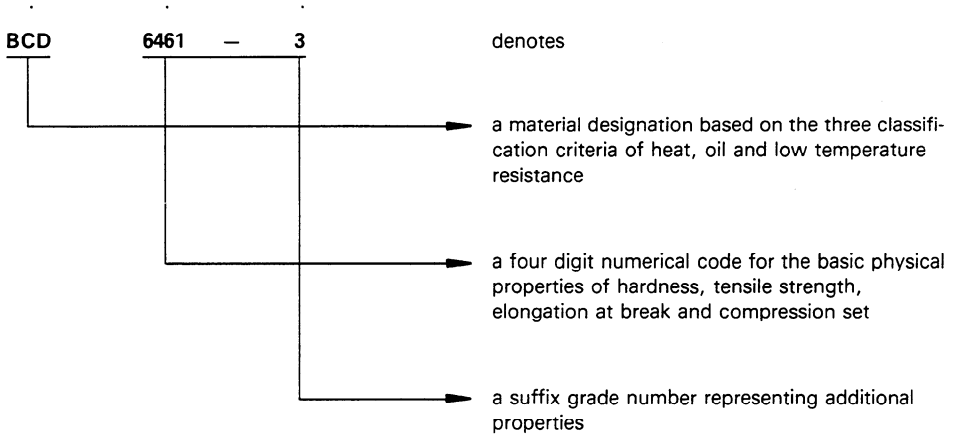
SE Sweden

US United States of America

3.1.2 The classification system, methods of test, test conditions and properties to be tested are specified in ISO 4632/1.

3.1.3 As far as possible the values of properties given in this Technical Report have been brought into line with the list of preferred gradations in ISO 1433.

3.1.4 Each material listed in table 1 has its own code consisting of a combination of letters and digits. This code can be used for information retrieval by punched cards or digital computer. An example is shown in the figure.



Figure

3.2 Composition and manufacture

This classification system applies to materials manufactured from natural rubber, synthetic rubber or reclaimed rubber, alone or in combination, together with added compounding ingredients of such nature and quantity as to produce vulcanizates that comply with the specified requirements. All materials and workmanship shall be in accordance with good commercial practice, and the resulting product shall be free of porous area, weak sections, bubbles, foreign matter or other defects affecting serviceability.

3.3 Sampling and inspection

3.3.1 A lot, unless specified otherwise, shall consist of all products of the same material submitted for inspection at the same time.

3.3.2 When proof of conformance with a specification based on this classification system is required, the supplier shall, upon request of the purchaser at the time of ordering, furnish a sufficient number of samples to perform the required tests. Test pieces shall be prepared as specified in ISO 4632/1. The samples shall be warranted to have equivalent cure and to be from the same run or batch of compound used in the lot.

3.3.3 When differences arise due to the method of processing or to the difficulty in obtaining suitable test pieces from a finished rubber product the values of properties may differ from those obtained from standard test pieces. Such differences in the values of properties for the rubber product shall be reported in an appropriate manner as agreed between the supplier and purchaser. Such differences in values can be determined by comparing results from standard test pieces with those obtained on actual rubber products.

3.4 Reporting

The specification code of a material taken from this Technical Report shall be prefaced by a reference to ISO/TR 8461. An example is as follows:

Rubber material, ISO/TR 8461 BAD 5373-3

or if the full line call out designation is required

Rubber material, ISO/TR 8461 BAD 5373-3 A14 C42 EA14 F10 F70 F80

4 Rubber materials

Rubber materials are listed in table 1.

NOTE — It is intended that rubber materials specified in any documents under the jurisdiction of ISO/TC 45 will be included in table 1.

Table 1 — Standard rubber materials

Basic physical properties	Suffix grade numbers available	Suffix	Requirements	Grade No. 1	Grade No. 2	Grade No. 3	Grade No. 4	Grade No. 5	Grade No. 6	Grade No. 7
Classification criteria: AAC										
CS 4163 CS 5153 CS 6162 CS 7373 CS 8143 SE 9323 CS 9323	No. 4 No. 4 Nos. 4; 5 No. 6 No. 7 No. 2 No. 3	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.			+ 10 – 20 – 20	+ 15 – 30 – 40	+ 10 – 30 – 30	+ 10 – 20 – 20	+ 10 – 20 – 20
		A23	Heat resistance, 7 days at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.		+ 10 – 30 – 40	+ 10 – 30 – 30				
		C12	Ozone resistance, 50 pphm, 96 h at 40 °C — threshold strain, %, min.			20				
		C42	Ozone resistance, 200 pphm, 96 h at 40 °C — threshold strain, %, min.					40		
		F10	Low temperature resistance — brittleness temperature, °C, max.		– 30					
		F70	Low temperature resistance — retraction temperature, TR-10, °C, max.	Basic properties only — no additional requirements	– 35					
		F80	Low temperature resistance — retraction temperature, TR-30, °C, max.		– 10					
		G11	Tear strength — crescent, kN/m, min.		60	60				
		O11	Electrical resistivity — Ω·cm							5×10^{11} to 5×10^{14}
		O21	Electrical insulation — resistance, MΩ, min.							1×10^{10}
		O31	Breakdown voltage — kV/mm, min.							15
		R11	Resilience — Lupke, %, max.						20	
		S71	Compression flexometer — temperature rise, °C, max. — creep, %, max. — set, %, max.						80 60 20	

Table 1 — Standard rubber materials (*continued*)

Classification criteria : AAD

Basic physical properties	Suffix grade numbers available	Suffix	Requirements	Grade No. 1	Grade No. 2	Grade No. 3	Grade No. 4	Grade No. 5	Grade No. 6
SE 3483 SE 4586 US 4793 US 5573 SE 5586 US 6353 SE 6576 US 6673 SE 7143 SE 7343 SE 7566 US 8543	No. 3 No. 2 No. 4 No. 4 No. 5 No. 2 No. 5 No. 4 No. 6 No. 6 No. 5 No. 2	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.	Basic properties only — no additional requirements	 + 10 – 30 – 30		 + 10 – 30 – 30		
		A23	Heat resistance, 7 days at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.		 + 10 – 30 – 40	 + 10 – 30 – 40		 + 10 – 30 – 30	 + 10 – 30 – 40
		B13	Compression set, 22 h at 70 °C — %, max.		25		25		
		C12	Ozone resistance, 50 pphm, 96 h at 40 °C — threshold strain, %, min.		20	10	10	20	10
		C42	Ozone resistance, 200 pphm, 96 h at 40 °C — threshold strain, %, min.		40				
		EA14	Aqueous fluid resistance, distilled water, 70 h at 100 °C — volume change, %, max.		10		10		
		F10	Low temperature resistance — brittleness temperature, °C, max.		– 50	– 50		– 50	
		F70	Low temperature resistance — retraction temperature, TR-10, °C, max.		– 45	– 50	– 40	– 40	– 30
		F80	Low temperature resistance — retraction temperature, TR-30, °C, max.		– 35	– 40	– 30	– 25	– 20
		G11	Tear strength — crescent, kN/m, min.		90	60		120	60
		K11	Adhesion to metals — two plate method, MPa, min.		—*		—*		

* Materials can be bonded to metal during vulcanization. Because of the wide variety of compounds in use and manifold end-use requirements, values should be agreed between supplier and user.

Table 1 — Standard rubber materials (*continued*)

Classification criteria : AAE					
Basic physical properties	**Suffix grade number available**	**Suffix**	**Requirements**	**Grade No. 1**	**Grade No. 2**
SE 3483	No. 2	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.	Basic properties only — no additional requirements	 + 10 − 20 − 20
		A23	Heat resistance, 7 days at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.		 + 10 − 30 − 40
		C12	Ozone resistance, 50 pphm, 96 h at 40 °C — threshold strain, %, min.		 10
		F70	Low temperature resistance — retraction temperature, TR-10, °C, max.		 − 50
		F80	Low temperature resistance — retraction temperature, TR-30, °C, max.		 − 40
		G11	Tear strength — crescent, kN/m, min.		 60

Table 1 — Standard rubber materials (*continued*)

Classification criteria: ABD									
Basic physical properties	**Suffix grade numbers available**	**Suffix**	**Requirements**	**Grade No. 1**	**Grade No. 2**	**Grade No. 3**	**Grade No. 4**	**Grade No. 5**	**Grade No. 6**
CS 5383 CS 6473 CS 6585 CS 7363 CS 7574	No. 1 Nos. 4; 6 Nos. 3; 5 No. 2 No. 3	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.		 + 10 − 20 − 30	 + 15 − 30 − 30	 + 10 − 20 − 20	 + 10 − 40 − 40	 + 5 − 20 − 20
		C42	Ozone resistance, 200 pphm, 96 h at 40 °C — threshold strain, %, min.		 120				
		G21	Tear strength — angle, kN/m, min.			 5			
		H11	Resistance to flex cracking (De Mattia) — kilocycles, min.			 10			
		J11	Abrasion resistance — index, min.	Basic properties only — no additional requirements		 60			
		O11	Electrical resistivity — Ω · cm						 5×10^6 to 1×10^{10}
		O21	Electrical insulation — resistance, MΩ, min.						 5×10^{10}
		R11	Resilience — Lupke, %, min.				 20	 50	
		S71	Compression flexometer — temperature rise, °C, max. — creep, %, max. — set, %, max.				 60 60 20	 60 40 15	

Table 1 — Standard rubber materials (*continued*)

Classification criteria: ABE						
Basic physical properties	**Suffix grade numbers available**	**Suffix**	**Requirements**	**Grade No. 1**	**Grade No. 2**	**Grade No. 3**
CS 4483 CS 4583 CS 6574	No. 2 No. 2 No. 3	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.		+ 15 − 10 − 30	+ 10 − 20 − 20
		G21	Tear strength — angle, kN/m, min.	Basic properties only — no additional requirements		20
		H11	Resistance to flex cracking (De Mattia) — kilocycles, min.			60
		J11	Abrasion resistance — index, min.			90

Table 1 — Standard rubber materials (*continued*)

Classification criteria: ACD						
Basic physical properties	**Suffix grade numbers available**	**Suffix**	**Requirements**	**Grade No. 1**	**Grade No. 2**	**Grade No. 3**
CS 5373	Nos. 2; 3	A13	Heat resistance, 70 h at 70 °C			
			— hardness change, IRHD, max.		+ 10	+ 10
			— tensile change, %, max.		− 30	− 30
			— elongation change, %, max.		− 30	− 30
		C12	Ozone resistance, 50 pphm, 96 h at 40 °C			
			— threshold strain, %, min.		20	
		EF11	Resistance to hydrocarbon liquids, liquid A, 70 h at 23 °C			
			— hardness change, IRHD, max.			− 10
			— tensile change, %, max.			− 20
			— elongation change, %, max.			− 30
			— volume change, %, max.			+ 15
		EF21	Resistance to hydrocarbon liquids, liquid B, 70 h at 23 °C			
			— hardness change, IRHD, max.			− 20
			— tensile change, %, max.	Basic properties only — no additional requirements		− 40
			— elongation change, %, max.			− 50
			— volume change, %, max.			+ 80
		EO13	Oil resistance, oil No. 1, 70 h at 70 °C			
			— hardness change, IRHD			− 5 to + 10
			— tensile change, %, max.			− 20
			— elongation change, %, max.			− 30
			— volume change, %			− 15 to + 10
		EO14	Oil resistance, oil No. 1, 70 h at 100 °C			
			— hardness change, IRHD			− 10 to + 10
			— tensile change, %, max.			− 30
			— elongation change, %, max.			− 30
			— volume change, %			− 10 to + 20
		EO33	Oil resistance, oil No. 3, 70 h at 70 °C			
			— hardness change, IRHD, max.			− 15
			— tensile change, %, max.			− 30
			— elongation change, %, max.			− 40
			— volume change, %, max.			+ 50

Table 1 — Standard rubber materials (*continued*)

Classification criteria: AHC							
Basic physical properties	**Suffix grade numbers available**	**Suffix**	**Requirements**	**Grade No. 1**	**Grade No. 2**	**Grade No. 3**	**Grade No. 4**
CS 6253 CS 6365 CS 8536	No. 3 No. 2 No. 4	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.		 + 10 − 20 − 20	 + 10 − 20 − 20	 + 10 − 10 − 30
		EF11	Resistance to hydrocarbon liquids, liquid A, 70 h at 23 °C — hardness change, IRHD (max.) — tensile change, %, max. — elongation change, %, max. — volume change, %, max.		 − 5 to 0 − 10 − 10 + 5	 0 to − 5 − 10 − 10 + 5	 (− 10) − 20 − 20 + 10
		EF21	Resistance to hydrocarbon liquids, liquid B, 70 h at 23 °C — hardness change, IRHD (max.) — tensile change, %, max. — elongation change, %, max. — volume change, %, max.	Basic properties only — no additional requirements	 (− 20) − 40 − 40 + 40	 (− 20) − 35 − 35 + 40	 0 to − 20 − 40 − 40 + 50
		EO13	Oil resistance, oil No. 1, 70 h at 70 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %		 − 10 to + 10 − 20 − 20 − 15 to + 5	 − 5 to + 10 − 20 − 20 − 10 to + 5	 − 10 to + 10 − 20 − 30 − 15 to + 5
		EO14	Oil resistance, oil No. 1, 70 h at 100 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %		 − 5 to + 15 − 20 − 30 − 20 to + 5	 − 5 to + 5 − 10 − 10 − 5 to + 10	 − 10 to + 10 − 20 − 30 − 15 to + 5
		EO33	Oil resistance, oil No. 3, 70 h at 70 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %, max.		 − 10 to + 5 − 20 − 20 + 15	 − 10 to + 10 − 20 − 30 + 20	
		F10	Low temperature resistance — brittleness temperature, °C, max.				 − 15

Table 1 — Standard rubber materials *(continued)*

Classification criteria : AKB					
Basic physical properties	Suffix grade number available	Suffix	Requirements	Grade No. 1	Grade No. 2
CS 9424	No. 2	A13	Heat resistance, 70 h at 70 °C — hardness change, IRHD, max. — tensile change, %, max. — elongation change, %, max.	Basic properties only — no additional requirements	 + 10 – 20 – 20
		EF11	Resistance to hydrocarbon liquids, liquid A, 70 h at 23 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %		 – 5 to + 10 – 20 – 20 – 10 to + 5
		EF21	Resistance to hydrocarbon liquids, liquid B, 70 h at 23 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %, max.		 – 10 to 0 – 30 – 30 + 30
		EO13	Oil resistance, oil No. 1, 70 h at 70 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %		 – 5 to + 10 – 20 – 20 – 10 to + 5
		EO14	Oil resistance, oil No. 1, 70 h at 100 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %		 – 20 to + 5 – 20 – 30 – 15 to + 5
		EO33	Oil resistance, oil No. 3, 70 h at 70 °C — hardness change, IRHD — tensile change, %, max. — elongation change, %, max. — volume change, %		 – 10 to + 10 – 20 – 30 – 10 to + 10
		F10	Low temperature resistance — brittleness temperature, °C, max.		 – 20

Table 1 — Standard rubber materials (*continued*)

Classification criteria: AKC							
Basic physical properties	**Suffix grade numbers available**	**Suffix**	**Requirements**	**Grade No. 1**	**Grade No. 2**	**Grade No. 3**	**Grade No. 4**
US 4173 US 5173 US 6263 CS 6263 US 7323 CS 8434	No. 2 No. 2 No. 2 No. 3 No. 2 No. 4	A13	Heat resistance, 70 h at 70 °C				
			— hardness change, IRHD, max.			+ 10	+ 10
			— tensile change, %, max.			− 20	− 20
			— elongation change, %, max.			− 30	− 40
		A14	Heat resistance, 70 h at 100 °C				
			— hardness change, IRHD, max.		+ 15		
			— tensile change, %, max.		− 20		
			— elongation change, %, max.		− 40		
		EF11	Resistance to hydrocarbon liquids, liquid A, 70 h at 23 °C				
			— hardness change, IRHD, max.			− 5	− 5
			— tensile change, %, max.			− 10	− 10
			— elongation change, %, max.			− 10	− 10
			— volume change, %, max.			+ 5	+ 5
		EF21	Resistance to hydrocarbon liquids, liquid B, 70 h at 23 °C				
			— hardness change, IRHD, max.			− 10	
			— tensile change, %, max.			− 20	
			— elongation change, %, max.			− 30	
			— volume change, %, max.	Basic properties only — no additional requirements	+ 30	+ 15	
		EO13	Oil resistance, oil No. 1, 70 h at 70 °C				
			— hardness change, IRHD (max.)			(− 15)	+ 10 to − 10
			— tensile change, %, max.			− 20	− 30
			— elongation change, %, max.			− 30	− 40
			— volume change, %			0 to − 20	+ 5 to − 15
		EO14	Oil resistance, oil No. 1, 70 h at 100 °C				
			— hardness change, IRHD, max.			− 15	+ 15
			— tensile change, %, max.			− 20	− 30
			— elongation change, %, max.			− 30	− 40
			— volume change, %		− 5 to + 5	0 to − 20	0 to − 15
		EO33	Oil resistance, oil No. 3, 70 h at 70 °C				
			— hardness change, IRHD			− 5 to + 10	+ 10 to − 10
			— tensile change, %, max.			− 20	− 30
			— elongation change, %, max.			− 20	− 30
			— volume change, %			− 10 to + 5	+ 10 to − 10
		EO34	Oil resistance, oil No. 3, 70 h at 100 °C				
			— hardness change, IRHD		− 5 to + 10		
			— tensile change, %, max.		− 30		
			— elongation change, %, max.		− 50		
		F10	Low temperature resistance				
			— brittleness temperature, °C, max.		− 40		

Table 1 — Standard rubber materials (*continued*)

Classification criteria : AKD

Basic physical properties	Suffix grade number available	Suffix	Requirements	Grade No. 1	Grade No. 2
CS 7323	No. 2	A13	Heat resistance, 70 h at 70 °C	Basic properties only — no additional requirements	
			— hardness change, IRHD, max.		+ 10
			— tensile change, %, max.		− 20
			— elongation change, %, max.		− 40
		EF11	Resistance to hydrocarbon liquids, liquid A, 70 h at 23 °C		
			— hardness change, IRHD, max.		− 5
			— tensile change, %, max.		− 10
			— elongation change, %, max.		− 10
			— volume change, %		+ 5
		EF21	Resistance to hydrocarbon liquids, liquid B, 70 h at 23 °C		
			— hardness change, IRHD, max.		− 15
			— tensile change, %, max.		− 30
			— elongation change, %, max.		− 30
			— volume change, %, max.		+ 30
		EO13	Oil resistance, oil No. 1, 70 h at 70 °C		
			— hardness change, IRHD, max.		+ 10
			— tensile change, %, max.		− 30
			— elongation change, %, max.		− 30
			— volume change, %		− 10 to 0
		EO14	Oil resistance, oil No. 1, 70 h at 100 °C		
			— hardness change, IRHD, max.		+ 15
			— tensile change, %, max.		− 30
			— elongation change, %, max.		− 40
			— volume change, %		− 15 to 0
		EO33	Oil resistance, oil No. 3, 70 h at 70 °C		
			— hardness change, IRHD		+ 5 to − 5
			— tensile change, %, max.		− 10
			— elongation change, %, max.		− 10
			— volume change, %		+ 5 to − 5