
**Footwear — Critical substances
potentially present in footwear and
footwear components — Lists of
critical chemical substances**

*Chaussures — Substances critiques potentiellement présentes dans la
chaussure et les composants de chaussures — Listes des substances
chimiques critiques*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 216, *Footwear*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 309, *Footwear*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO/TR 16178:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

- new [Table 1](#) including a new system of grading;
- withdrawn substances:
 - proteins in latex, substances destroying ozone layer, polychlorobiphenyls, polychloroprene, vinyl chloride;
- added substances:
 - benzene, bisphenol, NMP, DMAC, phenyl mercury, quinoline, VOC;
- biocides are grouped together (CMK, OIT, OPP, TCMTB);
- Annex A is now in ISO 21061^[67];
- Annex B is now [Clause 5](#);
- bibliography, updated.

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.

Footwear — Critical substances potentially present in footwear and footwear components — Lists of critical chemical substances

1 Scope

This document defines lists of critical chemical substances potentially present in footwear and footwear components.

This document describes the critical chemical substances, their potential risks of nocuousness, in which materials they could be found, and which test method(s) can be used to quantify them.

The test methods listed indicate the state of the art. For some substances, a test method is not available.

This document is applicable to any kind of footwear and footwear components.

2 Normative references

There are no normative references in this document.

3 Terms and definitions (standards.iteh.ai)

For the purposes of this document, the following terms and definitions 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/>

3.1

allergen

substance that is capable of inducing an allergic reaction

3.2

allergy

immunologically mediated response to certain specific substances (allergens)

Note 1 to entry: Type-1 allergy (respiratory allergy) is mediated by IgE antibodies, can cause asthma, rhinitis, urticaria. Type-4 allergy (dermal allergy) is mediated by T-cells, can cause dermatitis.

3.3

limit of detection

value from which a substance is considered as detectable

Note 1 to entry: This means that the signal associated to the substance is three times bigger than the background noise signal. The limit of detection is determined experimentally by the laboratory for each substance.

3.4

critical substances

chemical substance that can be found in footwear or footwear components and can have an effect on the wearer and/or environmental impact due to its chemical reactivity

Note 1 to entry: The effects caused by critical substances vary. It can be carcinogenic or mutagenic effects, allergy, reaction to toxics, etc.

3.4.1

critical substances category 1

substances with proven dangerous effect on the wearer

Note 1 to entry: These substances are widely restricted by national regulation in several countries.

3.4.2

critical substances category 2

substances with dangerous effect on the wearer

Note 1 to entry: These substances are restricted by national regulation in a limited number of countries.

3.4.3

critical substances category 3

substances that are highly suspected to have an effect on the wearer

Note 1 to entry: These substances might not be restricted by regulation at the time of publication but they are frequently requested by the market stakeholders.

3.4.4

critical substances category 4

substances that are suspected to have an effect on the wearer

Note 1 to entry: These substances might not be restricted by regulation. Substances known to have an allergenic effect on the wearer are included in category 4 for reference.

4 Presence of chemicals in footwear materials

A number of chemicals are present in footwear materials. [Table 1](#) lists the following:

- a) in which materials they are supposed to be. The possible materials potentially used in the footwear industry are given in ISO 21061:2021, Annex C;
- b) a list of critical chemicals, (see [Clause 5](#) for information);
- c) test methods that can be used to quantify them (see Bibliography);
- d) the potential risks associated with their use, assessed by the use of the critical substances' category scale
 - 1) stand for "critical substances category 1";
 - 2) stand for "critical substances category 2";
 - 3) stand for "critical substances category 3";
 - 4) stand for "critical substances category 4".

For composite materials, the tests should be conducted on the entire component.

EXAMPLE 1 Coated textile (cotton + PVC coating). Test on PVC and test on cellulosic natural fibres should be done.

EXAMPLE 2 Mixed textile (PES + cotton). Test on cellulosic natural textile and test on PES textile should be done.

Table 1 — Critical chemicals potentially present in footwear and footwear components

Substance (see Annex B)	Test method	Leather			Synthetic material								Natural material				Miscellaneous					
		Leather	Coated leather	Leather board	PVC	EVA	Rubber	PU - TPU elastane	PE-T PP	Polyester	Polyamide	Chloride fibre	Polyacrylic	Latex	Cellulosic natu- ral textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose	
Acrylonitrile							4					4						4				
Alkylphenols(OP, NP) and Alkylpheno- lethoxylates, (OPEO, NPEO)	ISO 18218-1 ISO 18218-2	3	3	3																		
Alkylphenols(OP, NP) and Alkylpheno- lethoxylates, (OPEO, NPEO)	ISO 18254-1 ISO 21084								2	2	2	2		2	2					2		
AZO - arylamines	ISO 17234-1	1	1	1																		
When 4-aminoa- zobenzene is sus- pected	ISO 17234-2	1	1	1																		
AZO - arylamines	ISO 14362-1								1	1	1	1		1	1						1	
When 4-aminoa- zobenzene is sus- pected	ISO 14362-3								1	1	1	1		1	1						1	
Benzene									1	1	1	1		1	1			2				
Biocides (TCMTB, OIT, CMK)	ISO 13365-1 and ISO 13365- 2	4	4	4					4	4	4	4		4	4		4					4
Biocides (OPP)	ISO 13365-1 and ISO 13365- 2	2	2	2					2	2	2	2		2	2		2					2
Biocides (triclosan)	EN 17134	2	2	2					2	2	2	2		2	2		2					2
Bisphenol		2	2	2																		
Cadmium	EN 1122		1		1	1	1	1	1	1	1											1
Chlorinated paraffin's (Short chained [C10-C13])	ISO 18219-1	2	2	2					2	2	2	2		2	2		2					2

Table 1 (continued)

Substance (see Annex B)	Test method	Leather			Synthetic material								Natural material				Miscellaneous					
		Leather	Coated leather	Leather board	PVC	EVA	Rubber	PU - TPU elastane	PE-T PP	Polyester	Polyamide	Chloride fibre	Polyacrylic	Latex	Cellulosic natu- ral textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose	
Chlorinated paraffin's (Middle chained [C14-C17])	ISO 18219-2	3	3	3			3			3	3	3	3	3	3					3		
	EN 17137								2													
Chlorobenzene and chlorotoluene Chlorobenzene and chlorotoluene (tetra- chlorotoluene, trichlorotoluene, αchlo- rotoluene)	EN 17137									2	2	2	2	2	2							
	ISO 17075-1	1	1	1																		
Chromium VI	ISO 17075-2																					
Chromium VI	ISO 10195	3	3	3																		
Colophony																						4
Dimethylformamide (DMF)	ISO 16189		2																			
Dimethylfumarate (DMFu)	ISO 16186	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Disperses dyes and dyestuffs	ISO 16373-2																					
	ISO 16373-3																					
Flame retard- ant (Phosphorated and brominat- ed)	ISO 17881-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	ISO 17881-2																					
Formaldehyde	ISO 17226-1	2	2	2																		
	ISO 17226-2																					
Formaldehyde	EN 120																					
Formaldehyde	EN 717-3																					
Formaldehyde	ISO 27587																					3
Formaldehyde	ISO 14184-1								1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 1 (continued)

Substance (see Annex B)	Test method	Leather			Synthetic material								Natural material				Miscellaneous				
		Leather	Coated leather	Leather board	PVC	EVA	Rubber	PU - TPU elastane	PE-T PP	Polyester	Polyamide	Chloride fibre	Polyacrylic	Latex	Cellulosic natu- ral textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose
Extractible (Sb - As - Cd - Cr - Co - Cu - Ni - Hg - Zn)	ISO 17072-1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	EN 16711-2																				
E x t r a c t i b l e Footwear for children less than 36 months	ISO 17072-1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	EN 16711-2																				
Heavy metals (Sb - As - Cd - Cr - Co - Cu - Ni - Hg - Zn - Ba - Se)	ISO 17072-2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	EN 16711-1																				
Total content (Sb - As - Cd (leather and textile) - Cr - Co - Cu - Ni - Hg - Zn)	ISO 19050	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	ISO 17072-2																				
Lead	EN 16711-1																				
	ISO 17072-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mercaptobenzothiazole							4														
N-ethylphenyl-amine							4						4								
N methyl pyrrolidone	ISO 19070				2				2						2						2
N,N-dimethylacetamide (DMAc)															2						2
Nickel	EN 1811 (with or with- out EN 12472)																		1		
	Skin contact																				
Nitrosamines	Footwear for chil- dren less than 36 months						2														
	ISO 19577						4														
Organotin compounds (TBT, TPT)	ISO 19577																				
	ISO/TS 16179	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 1 (continued)

Substance (see Annex B)	Test method	Leather			Synthetic material										Natural material					Miscellaneous			
		Leather	Coated leather	Leather board	PVC	EVA	Rubber	PU - TPU elastane	PE-T PP	Polyester	Polyamide	Chloride fibre	Polyacrylic	Latex	Cellulosic natu- ral textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose		
Organotin compounds(DBT, DOT)	ISO/TS 16179	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Organotin compounds(others)	ISO/TS 16179	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
PAH - polycyclic aromatic hydrocarbons	ISO/TS 16190	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Paraphenylenediamine																							
Pesticides	ISO 22517	3	3	3																			
PFCs perfluorinated compounds (PFOS/ PFOA)	CEN/TS 15968																						
PFCs perfluorinated compounds	ISO 23702-1	1	1	1																			
pH	ISO 4045	2	2	2																			
pH	ISO 3071																						
Phenol	ISO 20536	4	4	4																			
Phenyl mercury																							
Phthalates	Footwear for children less than 14 years ISO 16181 (all parts) ISO 14389	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Phthalates	ISO 16181 (all parts) ISO 14389		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Polychlorophenol (PCP pentachlorophenol)	ISO 17070	1	1	1																			
Polychlorophenol TeCP	ISO 17070	2	2	2																			
Polychlorophenol TriCP - DiCP	ISO 17070	3	3	3																			
Polychlorophenol (PCP pentachlorophenol)	CEN/TR 14823																						
Polychlorophenol (PCP pentachlorophenol)	XP G 08-015				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Polychlorophenol TeCP	XP G 08-015																						
Polychlorophenol TriCP - DiCP - MoCP	XP G 08-015																						

Table 1 (continued)

Substance (see Annex B)	Test method	Leather			Synthetic material								Natural material				Miscellaneous					
		Leather	Coated leather	Leather board	PVC	EVA	Rubber	PU - TPU elastane	PE-T PP	Polyester	Polyamide	Chloride fibre	Polyacrylic	Latex	Cellulosic natu- ral textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose	
PTBF Parateritary butyl phenol formal- dehyde																		4				
Quinoline							2	2	2	2			2									
Thiuram and Thiocarbamate							4															
Volatile organic compounds			4			4	4	4	4	4												4

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5 Critical substances potentially present in footwear and footwear components

In this document, the chemicals are identified by their CAS Registry Number¹⁾ (CAS RN[®]).

5.1 Acrylonitrile

5.1.1 General

Chemical compound with the formula CH₂CHCN.

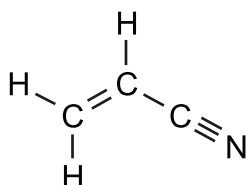


Figure 1 — Acrylonitrile molecular structure

This pungent-smelling colourless liquid often appears yellow due to impurities. It is an important monomer for the manufacture of useful plastics. In terms of its molecular structure, it consists of a vinyl group linked to a nitrile.

Acrylonitrile (CAS RN[®] 107-13-1) is used principally as a monomer in the manufacture of synthetic polymers, especially polyacrylonitrile, which comprises acrylic fibres. Acrylic fibres are, among other uses, precursors for well-known carbon-fibre. It is also a component of synthetic rubber.

Synthetic rubber, essentially based on SBR (Styrene-butadiene rubber) and containing acrylonitrile has some properties which are suitable as material for soles, especially for soles in professional high resistance footwear.

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5.1.2 Potential risks

Acrylonitrile is highly flammable and toxic. It undergoes explosive polymerization. The burning material releases fumes of hydrogen cyanide and oxides of nitrogen. Acrylonitrile is classified as a recognized human carcinogen.

When polymerized or in composition as synthetic rubber, it is considered as inert material and no particular problems rise in using acrylonitrile.

In footwear products, the presence of acrylonitrile is very rare.

5.1.3 Test methods

No standard is available at the time of publication of this document for acrylonitrile analysis in footwear and footwear components.

5.2 Alkylphenols and Alkylphenol ethoxylates (NP, OP, NPEO, OPEO)

5.2.1 General

Alkylphenols (AP) and alkylphenol ethoxylates (APEO), see [Table 2](#), are used in plastics, as additives, plasticizers and surface-active ingredients in industrial detergents and emulsifiers. Ethoxylated

1) CAS Registry Number[®] (CAS RN[®]) is a trademark of CAS corporation. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

alkylphenols, alkylphenol ethoxylates (APEO), are used as industrial surfactants in manufacture of wool and metal, as emulsifiers for emulsion polymerization, in laboratory detergents, and pesticides.

AP commonly used are nonylphenol (NP) and, to a lesser extent, octyl phenol (OP), in both cases predominantly the para-substituted isomers (>90 %). APEO are produced by a condensation reaction of AP with ethylene oxide. While the lower condensates (number of ethoxylate units about 4) are used as emulsifiers, the higher ethoxylates are used in textile and carpet cleaning and as emulsifiers in solvents and agricultural pesticides. As with the AP, nonylphenol ethoxylate (NPEO) is more used than octyl phenol ethoxylate (OPEO). AP are moderately soluble in water while the APEO are generally more water soluble than the parent AP themselves.

NOTE APEs are a component of some household detergents used outside the European Union (EU). Within the EU, due to environmental concerns, they are replaced by more expensive but safer alcohol ethoxylates.

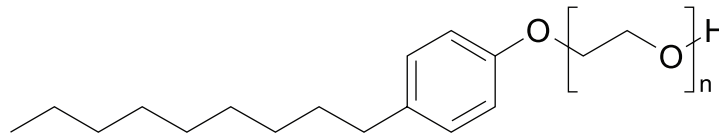


Figure 2 — Example of Alkylphenol ethoxylates molecular structure, nonylphenol ethoxylate

Table 2 — List of critical alkylphenols and alkylphenol ethoxylates

CAS RN®	Substances
104-40-5	Nonylphenol (NP), mixed isomers
11066-49-2	
25154-52-3	
84852-15-3	Octyl phenol (OP), mixed isomers
140-66-9	
1806-26-4	
27193-28-8	Octyl phenol ethoxylates (OPEO)
9002-93-1	
9036-19-5	
68987-90-6	Nonylphenol ethoxylates (NPEO)
9016-45-9	
26027-38-3	
37205-87-1	
68412-54-4	
127087-87-0	

5.2.2 Potential risks

If NPEO and OPEO are released to the environment, they can be degraded back to NP and OP, which are toxic to aquatic life, persistent in the environment and can bio-accumulate in body tissue. They are similar to natural oestrogen (endocrine disrupter) and can disrupt sexual development in some organism (feminization of fish).

5.2.3 Test methods

The content of Alkylphenol and Alkylphenol ethoxylates can be determined by the following:

- Leather: ISO 18218-1 or ISO 18218-2;