TECHNICAL REPORT

ISO/TR 16178

Third edition
2021-09

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

Reference number
ISO/TR 16178:2021(E)

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Published in Switzerland

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Foreword

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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 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— withdrawn substances: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

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[67], 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 natural textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose
Acrylonitrile							4						4					4			
Alkylphenols(OP, NP) and Alkylphenolethoxylates, (OPEO, NPEO)	ISO 18218-1 ISO 18218-2	3	3	3																	
Alkylphenols(OP, NP) and Alkylphenolethoxylates, (OPEO, NPEO)	ISO 18254-1 ISO 21084									2	2	2	2		2	2				2	
AZO - arylamines	ISO 17234-1	1	1	1																	
AZO - arylamines When 4-aminoazobenzene is suspected	ISO 17234-2	1	1	1																	
AZO - arylamines	ISO 14362-1									1	1	1	1		1	1				1	
AZO - arylamines When 4-aminoazobenzene is suspected	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	4				4
Biocides (OPP)	ISO 13365-1 and ISO 13365-2	2	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	2	2	2	2		2		2	2
Bisphenol		2	2	2																	
Cadmium All plastics (mainly PVC)	EN 1122		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 natural 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	
Chlorobenzene and chlorotoluene	EN 17137									2											
Chlorobenzene and chlorotoluene (tetrachorotoluene, trichlorotoluene, αchlorotoluene)	EN 17137									2	2	2	2		2	2					
Chromium VI	ISO 17075-1 ISO 17075-2	1	1	1																	
Chromium VI With ageing	ISO 10195	3	3	3																	
Colophony																		4			
Dimethylformamide (DMF)	ISO 16189		2					2													
Dimethylfumarate (DMFu)	ISO 16186	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									2	2	2	2		2	2				2	
Flame retardant (Phosphorated and brominated) Only for product claiming FR properties	ISO 17881-1 ISO 17881-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1
Formaldehyde	ISO 17226-1 ISO 17226-2	2	2	2																	
Formaldehyde	EN 120 EN 717-3																2				2
Formaldehyde	ISO 27587																	3			
Formaldehyde	ISO 14184-1									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 natural textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose
Heavy metals	Extractible (Sb – As –Cd – Cr – Co – Cu – Ni – Hg – Zn)	ISO 17072-1 EN 16711-2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		3	3
	E x t r a c t i b l e Footwear for children less than 36 months (Sb – As –Cd – Cr – Co – Cu – Ni – Hg – Zn – Ba – Se)	ISO 17072-1 EN 16711-2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	2
	Total content (Sb – As –Cd (leather and textile) – Cr – Co – Cu – Ni – Hg – Zn)	ISO 17072-2 EN 16711-1 ISO 19050	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		3	3
Lead		ISO 17072-2 EN 16711-1	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	2	2		2	2				2	
N,N-dimethylacetamide (DMAC)											2	2	2	2		2	2				2	
Nickel	Skin contact	EN 1811 (with or without EN 12472)																		1		
Nitrosamines	Footwear for children less than 36 months	ISO 19577						2														
Nitrosamines		ISO 19577						4														
Organotin compounds (TBT, TPT)		ISO/TS 16179	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 natural 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
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
PAH – polycyclic aromatic hydrocarbons	ISO/TS 16190	1	1	1	1	1	1	1	1		2	2	2		2	2		1		2	
Paraphenylene diamine										4	4		4		4	4				4	4
Pesticides	ISO 22517	3	3	3											3	3					3
PFCs perfluorinated compounds (PFOS/PFOA)	CEN/TS 15968									1	1	1	1		1	1					
PFCs perfluorinated compounds	ISO 23702-1	1	1	1																	
pH	ISO 4045	2	2	2																	
pH	ISO 3071									2	2	2	2		2	2					
Phenol	ISO 20536	4	4	4			4								4	4		4			4
Phenyl mercury								1													
Phthalates – Footwear for children less than 14 years	ISO 16181 (all parts) ISO 14389		1		1	1	1	1										1		1	
Phthalates	ISO 16181 (all parts) ISO 14389		2		2	2	2	2										2		2	
Polychorophenol (PCP pentachlorophenol)	ISO 17070	1	1	1																	
Polychorophenol TeCP	ISO 17070	2	2	2																	
Polychorophenol TriCP – DiCP	ISO 17070	3	3	3																	
Polychorophenol (PCP pentachlorophenol)	CEN/TR 14823																1				
Polychorophenol (PCP pentachlorophenol)	XP G 08-015									1	1	1	1		1	1				1	
Polychorophenol TeCP	XP G 08-015														2	2				2	
Polychorophenol TriCP – DiCP – MoCP	XP G 08-015														3	3				3	

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 natural textile	Proteinic natural textile	Wood - cork	Adhesives	Metal hardware	Prints for textile	Cellulose
PTBF Paratertiary butyl phenol formaldehyde																		4			
Quinoline								2	2	2	2		2	2							
Thiuram and Thiocarbamate							4														
Volatile organic compounds			4			4	4	4	4	4	4	4	4					4			

5 Critical substances potentially present in footwear and footwear components

In this document, the chemicals are identified by their CAS Registry Number®[1)] (CAS RN®).

5.1 Acrylonitrile

5.1.1 General

Chemical compound with the formula CH_2CHCN.

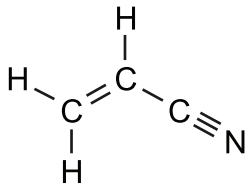


Figure 1 — Acrylonitrile molecular structure

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.

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.

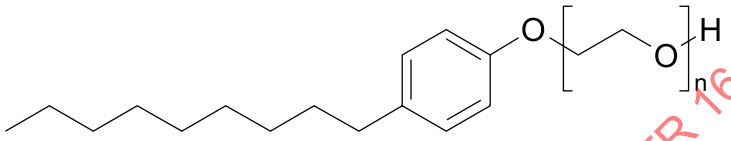


Figure 2 — Example of Alkylphenol ethoxylates molecular structure, nonylphenol ethoxylate

Table 2 — List of critical alkylphenols and alkylphenol ethoxylates

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

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:

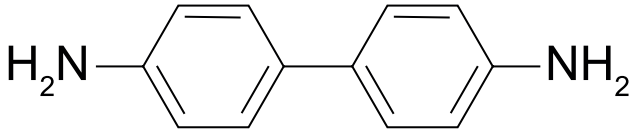
— Leather: ISO 18218-1 or ISO 18218-2;

— Textile: ISO 21084, ISO 18254-1 and ISO 18254-2.

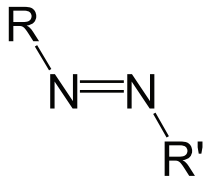
5.3 Aromatic amines

5.3.1 General

Amine with an aromatic substituent, that is -NH_2, -NH- or nitrogen group(s) attached to an aromatic hydrocarbon, whose structure usually contains one or more benzene rings. Benzidine is an example (see Figure 3 a). Aromatic amines are produced during the degradation of azo-dyes (see Figure 3 b). The list of the critical amines is given in Table 3.



a) Example of aromatic amines molecular structure; benzidine



b) Molecular structure of the azo function

Figure 3 — Molecular structures

Table 3 — List of critical aromatic amines developed by azo-dyestuffs

Substances	CAS RN®	Substances	CAS RN®
4-aminobiphenyl	92-67-1	3,3'-dimethyl-4,4'-diaminodiphenylmethane	838-88-0
Benzidine	92-87-5	p-cresidine	120-71-8
4-chloro-o-toluidine	95-69-2	4,4'-methylen-bis(2-chloraniline)	101-14-4
2-naphthylamine	91-59-8	4,4'-oxydianiline	101-80-4
o-aminoazotoluene	97-56-3	4,4'-thiodianiline	139-65-1
2-amino-4-nitrotoluene	99-55-8	o-toluidine	95-53-4
p-chloroaniline	106-47-8	2,4-toluylendiamine	95-80-7
2,4-diaminoanisole	615-05-4	2,4,5-trimethylaniline	137-17-7
4,4'- diaminodiphenylmethane	101-77-9	2,4-dimethylaniline (= 2,4-Xylidine)[a]	95-68-1
3,3'-dichlorobenzidine	91-94-1	2,6-dimethylaniline (= 2,6-Xylidine)[a]	87-62-7
3,3'-dimethoxybenzidine	119-90-4	2-methoxyaniline (=o-anisidine)	90-04-0
3,3'-dimethylbenzidine	119-93-7	4-aminoazobenzene	60-09-3

[a] Not restricted under European Regulation Reach annex 17 but these substances can be restricted in other countries, e.g. in China.

Salts of these aromatic amines can also be mentioned (see Table 4) in the legislation.

Table 4 — List of critical aromatic amines residue of dyestuffs production

Substance	CAS RN®
4-chloro-o-toluidinium chloride	3165-93-3
2-Naphthylammoniumacetate	553-00-4

Table 4 *(continued)*

Substance	CAS RN®
2,4-diaminoanisole sulphate	39156-41-7
2,4,5-trimethylaniline hydrochloride	21436-97-5

5.3.2 Potential risks

The aromatic amines given in Table 3 and 4 are known to be carcinogenic (4-aminobiphenyl, benzidine, 4-chlor-o-toluidine, 2-naphthylamine) or suspected to be carcinogenic (others). These substances are restricted in many countries in the world.

5.3.3 Test methods

The content of aromatic amines can be tested with one of the following test methods:

— Leather: ISO 17234-1, ISO 17234-2

— Textile: ISO 14362-1, ISO 14362-3

5.4 Benzene

5.4.1 General

Benzene (CAS RN® 71-43-2) is an important organic chemical compound (see Figure 4). Benzene is a natural constituent of crude oil and is one of the elementary petrochemicals. Due to the cyclic continuous pi-bond between the carbon atoms, benzene is classed as an aromatic hydrocarbon.

This substance has been identified in several studies as a contaminant in the textile industry and in the production of synthetic fibre. The substance can be removed but is sometimes present in final products if processes are not optimized. Another response identified that mineral oil-based preparation agents are used for natural and synthetic fibres in fibre and yarn processing as well as in fabric formation. These uses include twisting oils, coning and warping oils, knitting oils, spinning and combing oils, and batching oils. Mineral oils are also used as additives for printing thickeners and in antifoaming agents. Waxes and paraffin are used in the sizing process. Preparation agents, printing thickeners, antifoaming agents, and sizing agents are textile auxiliaries that are removed in the textile manufacturing process by washing processes but can be present as impurities in the final product. In footwear, the major risk of presence of benzene is in the solvent based adhesive.

Figure 4 — Benzene molecular structure

5.4.2 Potential risks

Benzene is classified as a carcinogenic, which increases the risk of cancer and other illnesses, and is also a notorious cause of bone marrow failure. Substantial quantities of epidemiologic, clinical, and laboratory data link benzene to several diseases.

5.4.3 Test methods

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

NOTE Benzene can be analysed by headspace/GC-MS as the VOC, see 5.37.

5.5 Biocides

5.5.1 Orthophenylphenol

5.5.1.1 General

2-Phenylphenol, or *o*-phenylphenol, or orthophenylphenol (CAS RN® 90-43-7, see Figure 5) is an organic compound that consists of two linked benzene rings and a phenolic hydroxyl group. It is a biocide used as a preservative.

The primary use of 2-phenylphenol is as an agricultural fungicide. It is also used for disinfection on fibres and other materials like leather. It is used to sterilize hospital and veterinary equipment. Other uses are in rubber industry and as a laboratory reagent. It is also used in the manufacture of other fungicides, dye stuffs, resins and rubber chemicals.

The sodium salt of orthophenylphenol, sodium orthophenylphenol, is used as a preservative.

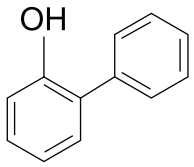


Figure 5 — Orthophenylphenol molecular structure

5.5.1.2 Potential risks

Eye contact can cause severe irritation and burns with possible eye damage. For some individuals, 2-phenylphenol can also irritate the skin. It is linked with hyperactivity in children. This substance is known to be allergenic.

5.5.1.3 Test methods

The content of orthophenylphenol can be tested with the following test methods:

— Leather: ISO 13365-1 and ISO 13365-2

— Textile: EN 17134

5.5.2 2-(thiocyanatomethylthio)-1,3-benzothiazole (TCMTB)

5.5.2.1 General

TCMTB [2-(thiocyanatomethylthio)-1,3-benzothiazole] is a biocide used as a fungicide, see Figure 6. Its CAS RN® is 21564-17-0.

NOTE Another name for TCMTB is (2-benzothiazolylthio) methyl thiocyanate.

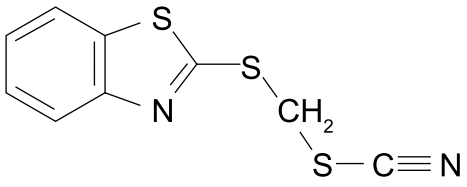


Figure 6 — TCMTB molecular structure

In certain conditions, TCMTB can degrade and generate MBT (see 5.18).

5.5.2.2 Potential risks

TCMTB is able to produce allergenic reactions. Furthermore, TCMTB can be irritating to the eyes, the respiratory system and the skin, and can be harmful if swallowed.

5.5.2.3 Test methods

The content of TCMTB can be tested with the following test methods:

— Leather: ISO 13365-1 and ISO 13365-2

5.5.3 2-octylisothiazol-3(2H)-one (OIT)

5.5.3.1 General

2-Octylisothiazol-3(2H)-one, abbreviated as OIT, (CAS RN® 26530-20-1, see Figure 7) is a broad-spectrum antifungal biocide used for the preservation of manufactured products, other than food stuffs or feeding stuffs, in containers. It controls microbial deterioration to ensure product shelf life during storage. It is also used in process systems such as metal-working tanks and wood treatment systems. The function of this product can vary from fungicide to bactericide, depending on the concentration.

Formulated products are designed for:

— In-can preservatives for the protection of household and institutional products, building materials, adhesives, latex and solvent-based paint films against bacteria, yeasts, and fungi.

— Preservatives for water-circulation and processing systems, including metal-working, wood treatment systems, etc.

— Preservatives for fibres, leather, rubber, plastics, and other polymers.

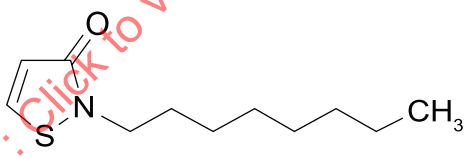


Figure 7 — OIT molecular structurePotential risks

According to the harmonized classification and labelling (CLP00) approved by the EU, this substance is toxic in contact with the skin, causes severe skin burns and eye damage, is toxic if inhaled, is very toxic to aquatic life with long lasting effects, is harmful if swallowed and can cause an allergic skin reaction.

5.5.3.2 Test methods

The content of OIT can be tested with the following test methods:

— Leather: ISO 13365-1 and ISO 13365-2

5.5.4 4-Chloro-3-methylphenol (CMK)

5.5.4.1 General

CMK, also known as PCMC, is as a general biocide used to prevent micro-organisms from degrading organic material. Its CAS RN® is 59-50-7, see Figure 8.

More than 50 % of the production volume of 4-chloro-3-methyl phenol is used in metal working fluids. These fluids are rich in proteins, which provide a source of nutrition for bacterial growth.

Other minor uses reported are the following: as a disinfectant, in external germicides, as a preservative for cosmetics, medications, glues, gums, paints, inks, textiles and leather goods.

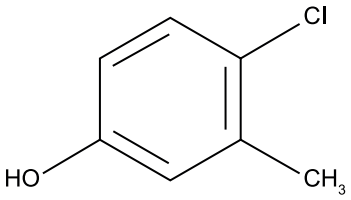


Figure 8 — CMK molecular structure

NOTE In the EU, CMK is included in the authorized biocides list.

5.5.4.2 Potential risks

According to the harmonized classification and labelling (CLP00) approved by the EU, this substance is very toxic to aquatic life, is harmful if swallowed, is harmful in contact with the skin, causes serious eye damage and can cause an allergic skin reaction.

5.5.4.3 Test methods

The content of 4-Chloro-3-methylphenol can be tested with the following test methods:

— Leather: ISO 13365-1 and ISO 13365-2

5.5.5 Triclosan

5.5.5.1 General

Triclosan (see Figure 9) is an antibacterial and antifungal agent found in some consumer products, including toothpaste, soaps, detergents, toys, and surgical cleaning treatments.

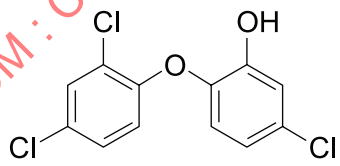


Figure 9 — triclosan structure

5.5.5.2 Potential risks

Its efficacy as an antimicrobial agent, the risk of antimicrobial resistance, and its possible role in disrupted hormonal development remain controversial. Additional research seeks to understand its potential effects on organisms and environmental health.

5.5.5.3 Test methods

The content of triclosan can be tested with the following test method:

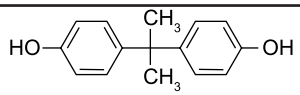
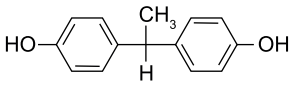
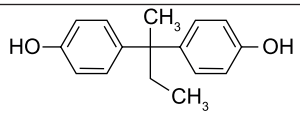
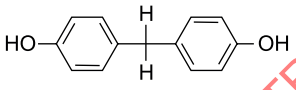
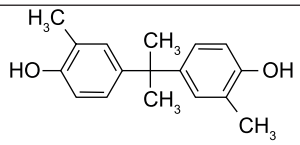
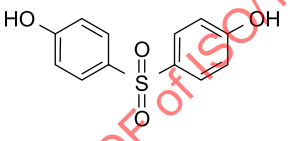
— Textile: EN 17134

5.6 Bisphenol

5.6.1 General

The bisphenols a group of chemical compounds (see Table 5) with two hydroxyphenyl functionalities. Most of them are based on diphenylmethane. The exceptions are bisphenol S, P, and M. "Bisphenol" is a common name; the letter following refers to one of the reactants.

Table 5 — Example of Bisphenol molecular structure

Structural formula	Name	CAS RN®	Structural formula	Name	CAS RN®
	Bisphenol A	80-05-7		Bisphenol E	2081-08-5
	Bisphenol B	77-40-7		Bisphenol F	620-92-8
	Bisphenol C	79-97-0		Bisphenol S	80-09-1

Bisphenol A (BPA) is the most popular representative of this group. BPA is a precursor to important plastics, primarily certain polycarbonates and epoxy resins. BPA-based plastic is clear and tough, and is made into a variety of common consumer goods, such as bottles and food storage containers. BPA is used in toners and printing ink for office copiers, fax machines and printers.

5.6.2 Potential risks

Bisphenols A (BPA) and S (BPS) have been shown to be endocrine disruptors. Due to its high production volumes, BPA has been characterized as a "pseudo-persistent" chemical, leading to its spreading and potential accumulation in a variety of environmental matrices.

5.6.3 Test methods

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

5.7 Cadmium – Cd

See 5.17.

5.8 Chlorinated paraffins

5.8.1 General

Chlorinated paraffins (CPs), see Table 6 and Figure 10, are a complex mixture of polychlorinated n-alkanes and were introduced in the 1930s. The chlorination degree of CPs can vary between 30 % and 70 %. CPs are subdivided according to their carbon chain length into short chain CPs (SCCPs, $C_{10\text{-}13}$), medium chain CPs (MCCPs, $C_{14\text{-}17}$) and long chain CPs (LCCPs, $C_{>17}$). Currently, over 200 CP formulations are in use for a wide range of industrial applications, such as flame retardants and plasticisers, and as additives in metal working fluids, in sealants, paints and coatings.

Table 6 — List of Chlorinated paraffins

	Substances	CAS RN®
SCCP	Short-chain chlorinated Paraffins (C10-C13)	85535-84-8
MCCP	Medium-chain chlorinated Paraffins (C14-C17)	85535-85-9

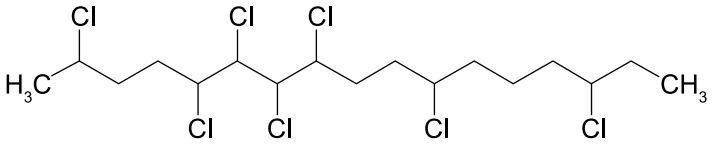


Figure 10 — Example of a Chlorinated paraffins molecular structure

5.8.2 Potential risks

Short chained chlorinated paraffines are classified as persistent and their physical properties imply a high potential for bioaccumulation. Furthermore, CPs are classified as toxic to aquatic organisms, and carcinogenic to rats and mice. SCCPs was categorized in group 2B as possibly carcinogenic to humans.

5.8.3 Test methods

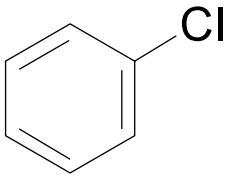
The content of Chlorinated paraffins can be tested with one of the following test methods:

— Leather: ISO 18219-1 (SCCP) and ISO 18219-2 (MCCP).

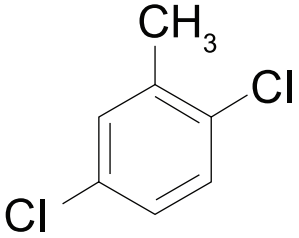
5.9 Chlorobenzenes and chlorotoluenes

5.9.1 General

Some chlorinated aromatic hydrocarbons (see Figure 11), chlorobenzenes are (or have been) used as dye carriers or levelling agents for dyeing, printing and coating. The halogenated carriers are mainly used in polyester manufacturing. Table 7 includes a list of some of these compounds.



b) Example of chlorobenzene molecular structure



a) Example of chlorotoluene molecular structure

Figure 11 — Examples of molecular structures

5.9.2 Potential risks

The substances listed in the Table 7 are toxic and some of them carcinogenic.

5.9.3 Test methods

The content of Chlorotoluene and chlorobenzene can be tested with the following test method:

— Textile: EN 17137

Table 7 — List of Chlorotoluenes and chlorobenzenes

Substances	CAS RN®
Dichlorobenzenes	1,2-DICHLOROBENZENE [95-50-1] 1,3-DICHLOROBENZENE [541-73-1] 1,4-DICHLOROBENZENE [106-46-7]
Trichlorobenzenes	1,2,3-TRICHLOROBENZENE [87-61-6] 1,2,4-TRICHLOROBENZENE [120-81-1] 1,3,5-TRICHLOROBENZENE [108-70-3]
Tetrachlorobenzenes	1-2-3-4 TETRACHLOROBENZENE [634-66-2] 1-2-3-5 TETRACHLOROBENZENE [634-90-2] 1-2-4-5 TETRACHLOROBENZENE [95-94-3]
Pentachlorobenzene	PENTACHLOROBENZENE [608-93-5]
Hexachlorobenzene	HEXACHLOROBENZENE [118-74-1]
Chlorotoluene	2-CHLOROTOLUENE [95-49-9] 3-CHLOROTOLUENE [108-41-8] 4-CHLOROTOLUENE [106-43-4] α-Chlorotoluene [100-44.7]
Dichlorotoluenes	2,3-DICHLOROTOLUENE [32768-54-0] 2,4-DICHLOROTOLUENE [95-73-8] 2,5-DICHLOROTOLUENE [19398-61-9] 2,6-DICHLOROTOLUENE [118-69-4] 3,4 DICHLOROTOLUENE [95-75-0]
Trichlorotoluenes	2,3,6-TRICHLOROTOLUENE [2077-46-5] 2,4,5-TRICHLOROTOLUENE [6639-30-1] α, α α TRICHLOROTOLUENE [98-07-7] α, 2,4 TRICHLOROTOLUENE [94-99-5] α, 2,6 TRICHLOROTOLUENE [2014-83-7] α, 3,4 TRICHLOROTOLUENE [102-47-6]
Tetrachlorotoluenes	α, α, 2,6 TETRACHLOROTOLUENE [81-19-6] α, α, α, 2–TETRACHLOROTOLUENE [2136-89-2] α, 4 – TETRACHLOROTOLUENE [5216-25-1]
Pentachlorotoluene	2,3,4,5,6-PENTACHLOROTOLUENE [877-11-2]

5.10 Chromium and Chromium VI

See 5.17.

5.11 Colophony

5.11.1 General

Colophony is also called 'Greek pitch' or 'rosin' (see Figure 12). The major part of rosin used in the world is obtained as by-product from the pulp industry and is known as tall oil rosin. These two types of rosin have not the same composition although the major products are in common, but a variation in the amounts of the different compounds is seen. These two types of rosin are often used for the same purposes. Modified tall oil rosin tends to be found more often in shoes.

Both types of rosin consist of 90 % resin acids and 10 % neutral material. In colophony of the gum rosin type, the major resin acid is abietic acid, while dehydroabietic acid dominates in tall oil rosin. 7-Oxo-dehydroabietic acid is a stable oxidation product that is used as a marker for the presence of other autoxidation products in rosin, e.g. 15-hydroperoxyabietic acid. The latter has been identified as the major allergen in colophony. However, this hydroperoxide is not suitable for analysis since it is not stable enough.

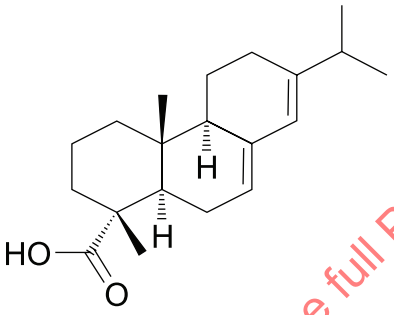


Figure 12 — Example of a colophony component molecular structure, abietic acid

Colophony is an ingredient in printing inks, varnishes, adhesives (glues), soap, paper sizing, soda, and, in past times, sealing wax.

5.11.2 Potential risks

Prolonged exposure to colophony fumes released during soldering can cause occupational asthma in sensitive individuals, therefore it is considered as an allergen.

Colophony is one of the most common causes of skin (contact) allergy which is caused by contact with colophony on the skin. It is on the top ten list of all skin allergens tested worldwide. Colophony in shoes is considered to be a dominating cause of sensitization in this aspect.

Colophony is classified in the EU legislation due to its skin sensitizing properties and products containing more than 1 % of colophony should be marked with R 43 (Can cause skin sensitization). However, in the EU legislation there is no demand for R 42 (lung allergy).

5.11.3 Test methods

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

5.12 Dimethylformamide

5.12.1 General

Dimethylformamide (see Figure 13) is an organic compound with the formula $(CH_3)_2NC(O)H$ (CAS RN® 68-12-2). It is commonly abbreviated as DMF (other possible abbreviations include DMFo and DMFa). DMF is a common solvent for chemical reactions. Pure dimethylformamide is odourless

whereas technical grade or degraded dimethylformamide often has a fishy smell due to impurity of dimethylamine (CAS RN® 68-12-2).

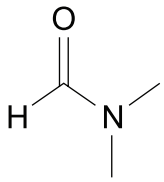


Figure 13 — Dimethylformamide molecular structure

The primary use of dimethylformamide is as a solvent with low evaporation rate. Dimethylformamide is used in the production of acrylic fibres and plastics. It is also used in the manufacture of adhesives, synthetic leathers, fibres, films, and surface coatings.

Solvent coated textiles can contain DMF as a residual solvent in acrylic fibres PU and PVC coating. It is also found as an impurity in man-made-fibres. Print and coated textiles are especially concerned.

5.12.2 Potential risks

Dimethylformamide is harmful by inhalation, ingestion or skin contact and might act as a carcinogen. Ingestion or absorption through skin might be fatal. Exposure might result in foetal death. Long-term exposure might result in kidney or liver damage. It is also irritant.

5.12.3 Test methods

The content of Dimethylformamide can be tested with the following test methods:

— Footwear: ISO 16189

— Textile: EN 17131

— Glove: EN 16778

5.13 Dimethylfumarate (DMFu)

5.13.1 General

Dimethylfumarate (CAS RN® 624-49-7), commonly abbreviated as DMFu (see Figure 14), is used to treat psoriasis. It is a lipophilic, highly mobile molecule in human tissue. However, as an α,β-unsaturated ester, dimethylfumarate reacts rapidly with the detoxifying agent glutathione by Michael addition.

Another use for Dimethylfumarate is mould inhibition. Dimethylfumarate is used also as a biocide.

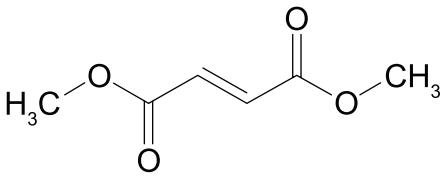


Figure 14 — Dimethylfumarate molecular structure

5.13.2 Potential risks

Dimethylfumarate has been found to be a sensitizer at very low concentrations, producing extensive, pronounced eczema that is difficult to treat. Low concentrations (about 1 ppm) can produce allergic reactions.

5.13.3 Test methods

The content of DMFu can be tested with the following test methods:

— Footwear: ISO 16186

— Textile: EN 17130

5.14 Disperses dyes

5.14.1 General

A dye can generally be described as a coloured substance that has an affinity to the substrate to which it is being applied. The dye is generally applied in an aqueous solution and might require a mordant to improve the fastness of the dye on the fibre. Both dyes and pigments appear to be coloured because they preferentially absorb some wavelengths of light. In contrast with a dye, a pigment is generally insoluble and has no affinity for the substrate. Some dyes can be precipitated with an inert salt to produce a lake pigment.

A list of carcinogenic dyes and of allergenic dyes is included in Table 8 and Table 9, respectively.

Table 8 — List of carcinogenic dyes

Name of dye	CAS RN®	Name of dye	CAS RN®
C.I. Direct Black 38	1937-37-7	C.I. Basic Blue 26 (with Michler's Ketone > 0,1 %)	2580-56-5
C.I. Direct Blue 6	2602-45-2	C.I. Basic Green 4 (malachite green chloride)	569-64-2
C.I. Acid Red 26	3761-53-3	C.I. Basic Green 4 (malachite green oxalate)	2437-29-8
C.I. basic red 9	569-61-9	C.I. Basic Green 4 (malachite green)	10309-95-2
C.I. Direct Red 28	573-58-0	Disperse orange 11	82-28-0
C.I. Basic Violet 14	632-99-5	Navy blue	118685-33-9
C.I. Disperse blue 1	2475-45-8	Basic Violet 3	548-62-9
C.I. Disperse blue 3	2475-46-9	Disperse yellow 23	6250-22-3

Table 9 — List of allergenic disperse dyes

Name of dye	CAS RN®	Name of dye	CAS RN®
Disperse blue 7	3179-90-6	Disperse red 17	3179-89-3
Disperse blue 26	3860-63-7	Disperse blue 35	12222-75-2
Disperse blue 102	69766-79-6	Disperse blue 106	12223-01-7
Disperse brown 1	23355-64-8	Disperse blue 124	61951-51-7
Disperse yellow 1	119-15-3	Disperse yellow 3	2832-40-8
Disperse yellow 9	6373-73-5	Disperse orange 3	730-40-5
Disperse yellow 39	12236-29-2	Disperse orange 37/59/76[a)]	12223-33-5
Disperse yellow 49	54824-37-2	Disperse red 1	2872-52-8
Disperse orange 1	2581-69-3	Dark blue 35	56524-77-7
Disperse red 11	2872-48-2		

Disperse dyes (see Table 8 and 9) were originally developed for the dyeing of cellulose acetate, and are not substantially water soluble. The dyes are finely ground in the presence of a dispersing agent and then sold as a paste, or spray-dried and sold as a powder.

They can also be used to dye Nylon, cellulose triacetate, polyester and acrylic fibres. In some cases, a dyeing temperature of 130 °C is required, and a pressurized dyebath is used. The very fine particle

size gives a large surface area that aids dissolution to allow uptake by the fibre. The dyeing rate can be significantly influenced by the choice of dispersing agent used during the grinding.

5.14.2 Potential risks

Certain of these dyes are carcinogenic or allergenic.

Navy blue cannot be tested, there is no available reference material, these substances have never been put on the market.

5.14.3 Test methods

The content of disperse dyes can be tested with the following test methods:

— ISO 16373-1, ISO 16373-2 and ISO 16373-3

— DIN 54231 was the first developed test method and is still frequently used

5.15 Flame retardants

5.15.1 General

Flame retardants (see Table 10) are materials that inhibit or resist the spread of fire. They can be naturally occurring substances, such as asbestos, as well as synthetic materials, usually halocarbons such as polybrominated diphenyl ether (PBDEs) or polychlorinated biphenyls (PCBs).

Flame retardants are added to polymers used in a wide range of materials such as electric and electronic equipment, paint, and textiles. Polybrominated diphenyl ethers (PBDE) are so-called additive flame retardants. PBDEs are used as commercial mixtures, with different degrees of bromination. Typically PBDEs can comprise up to 5 % to 20 % of the total weight of a product to which they are added. Since these chemicals are not chemically bound, they might "leak" from the polymer product, thus entering the environment.

NOTE HBCDD, PBDE and OBDE are mainly used in furniture and electronic and are not frequently used in the footwear industry. Some item of PPE footwear can have flame retardants intentionally added during manufacturing.

Table 10 — List of critical flame retardants

Substances		CAS RN®
DecaBDE	Decabromodiphenyl ether	1163-19-5
OctaBDE	2,2',3,3',4,4',5,6 octabrominated diphenyl ether 196	446255-38-3
	2,2',3,3',4,4',6,6' octabrominated diphenyl ether 197	446255-39-6
	2,2',3,4,4',5,5',6 octabrominated diphenyl ether 203	337513-72-1
	2,3,3',4,4',5,5',6 octabrominated diphenyl ether 205	446225-56-7
	Technical mixture of the 4 substances	32536-52-0
PentaBDE	pentabrominated diphenyl ether	32534-81-9
	2,2',4,4',5 pentabrominated diphenyl ether 99	60348-60-9
	2,2',4,4',6 pentabrominated diphenyl ether 100	189084-64-8
TEPA	(Tris-(azirinidyl)-phosphinoxid)	5455-55-1
TRIS	tris(2,3-dibromopropyl) phosphate	126-72-7
TCEP	(Tris(2-chloroethyl) phosphate)	115-96-8
HBCDD	hexabromocyclododecane	3194-55-6
These substances can be used in children slippers to meet with flammability requirements.		

Table 10 *(continued)*

Substances		CAS RN®
PBB	Polybromobiphenyl	59536-65-1
TBBPA	Tetrabromobisphenol A	79-94-7
BBMP	2,2-bis(bromomethyl)-1,3-propanediol	3296-90-0
TDCP	Tris(1,3-dichloro-isopropyl) phosphate	13674-87-8
BDBPP	Bis(2,3-dibromopropyl) phosphate	5412-25-9
TCCPP	Tris (1,3-dichloro-isopropyl) phosphate	16674-87-8
TBP	Tributyl phosphate	126-73-8
TPP	Triphenyl phosphate	115-86-6
TXP	Trixylyl phosphate	21155-23-1
These substances can be used in children slippers to meet with flammability requirements.		

5.15.2 Potential risks

PBDEs can be accumulated in human body and have harmful effects on human health and the environment. There is growing evidence that indicates that these chemicals can cause liver toxicity, thyroid toxicity, and neurodevelopmental toxicity.

5.15.3 Test methods

The content of flame retardants can be tested with the following test methods:

— Textile: ISO 17881-1 and ISO 17881-2

NOTE It is also possible to assess the possible presence of brominated flame retardants by a Brome screening analysis.

5.16 Formaldehyde

5.16.1 General

Formaldehyde (methanal) is the chemical compound with the formula H2CO. Formaldehyde exists in several forms aside from H2CO: cyclic trimer trioxane and polymer paraformaldehyde. Its CAS RN® is 50-00-0, see Figure 15.

Formaldehyde is an intermediate in the oxidation (or combustion) of methane as well as other carbon compounds. It can be found in the smoke from forest fires, in automobile exhaust, and in tobacco smoke. In the atmosphere, formaldehyde is produced by the action of sunlight and oxygen on atmospheric methane and other hydrocarbons. It thus becomes part of smog pollution.

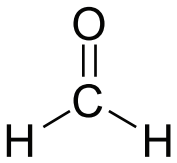


Figure 15 — Formaldehyde molecular structure

5.16.2 Potential risks

Formaldehyde can be toxic, allergenic, and carcinogenic. Because formaldehyde resins are used in many construction materials, formaldehyde is one of the more common indoor air pollutants. At concentrations above 0,1 ppm in air, formaldehyde can irritate the eyes and mucous membranes, resulting in watery eyes. If inhaled, formaldehyde at this concentration can cause headaches, a burning sensation in the

throat, and difficulty breathing, as well as triggering or aggravating asthma symptoms. Formaldehyde is classified as a probable human carcinogen. Sufficient evidence exists that formaldehyde might cause nasopharyngeal cancer in humans by the International Agency for Research on Cancer. Formaldehyde can cause allergies and is part of the standard patch test series.

5.16.3 Test methods

The content of formaldehyde can be tested with one of the following test methods:

— Wood: EN 120, EN 717-3

— Textile: ISO 14184-1

— Leather: Quantitative methods: ISO 17226-1, qualitative method: ISO 17226-2

5.17 Heavy metals

5.17.1 General

Heavy metals or metallic elements can be determined for different purposes.

In this document, Antimony (Sb), Arsenic (As), Barium (Ba), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se) and Zinc (Zn) are considered as heavy metals.

5.17.2 List of heavy metals

5.17.2.1 Extractible heavy metals

Extractible heavy metals (Sb, As, Ba, Pb, Cd, Cr, Co, Cu, Ni, Hg, Se and Zn) is the amount of metal that can be extracted from a material or a product using an extraction solution. The choice of the solution depend of the test goal. For example:

— water is used for waste leaching;

— hydrochloric acid solution to simulate ingestion; (never used for footwear);

— artificial perspiration to simulate the wear.

NOTE Barium is not a heavy metal and Selenium is a non-metal. However, they are generally included in the heavy metal list.

5.17.2.2 Total heavy metals

Total heavy metals (Sb, As, Ba, Pb, Cd, Cr, Co, Cu, Ni, Hg, Se and Zn) is the total amount of metal contained in a material or a product. The test method includes first a total digestion of the sample and after a metal quantification.

The heavy metal content is used most of the time to determine if a waste can be landfilled or not.

5.17.2.3 Heavy metal in footwear for children below 36 months old

Extractible heavy metals (Sb, As, Ba, Cd, Cr, Pb, Hg and Se) is the quantity of metals that can be extracted from a material or a product by an acid solution. This test should be done only in the cases where ingestion is possible.

5.17.3 Potential risks

Table 11 include a list of heavy metals and theirs associated potential risks.

Table 11 — List of heavy metals and associated risks

Metals	General	Potential risks
Antimony – Sb	Antimony is used in flame-proofing, paints, ceramics, enamels, a wide variety of alloys, electronics, and rubber. Antimony has been used in the production of polyester textile fibres.	Antimony and many of its compounds are toxic. Clinically, antimony poisoning is very similar to arsenic poisoning. In small doses, antimony causes headache, dizziness, and depression. Larger doses cause violent and frequent vomiting, and will lead to death within a few days.
Arsenic – As	Arsenic and its compounds are used as pesticides, herbicides, insecticides and various alloys.	Arsenic and many of its compounds are especially potent poisons. Arsenic disrupts ATP production through several mechanisms.
Barium – Ba		All water or acid soluble barium compounds are extremely poisonous. At low doses, barium acts as a muscle stimulant, while higher doses affect the nervous system, causing cardiac irregularities, tremors, weakness, anxiety, dyspnoea and paralysis.
Cadmium – Cd	Cadmium is used largely in batteries and pigments, for example in plastic products, especially PVC.	Cadmium and several cadmium-containing compounds are known carcinogens and can induce many types of cancer. Current research has found that cadmium toxicity might be carried into the body by zinc binding proteins. Cadmium is also a potential environmental hazard. Cadmium is one of six substances banned by the European Union's Directive on the restriction of certain hazardous substances in electric or electronic products Cd is banned in the European Regulation Reach annex 17.
Cobalt – Co	Cobalt and its compounds are used in the production of inks, paints, and varnishes.	Cobalt compounds should be handled with care due to cobalt's slight toxicity. Cobalt is known as an allergen can cause dermatitis (contact allergy).
Copper – Cu		All copper compounds, unless otherwise known, should be treated as if they were toxic. Symptoms of copper poisoning are very similar to those produced by arsenic. Fatal cases are generally terminated by convulsions, palsy, and insensibility.
Chromium – Cr	In the footwear sector, there are three oxidation states, stable in nature, metallic Cr, Cr III and Cr VI, and one substance can convert to another. Chromium compounds are used in dyes and paints, plating of metallic components and the tanning of leather.	Chromium metal and trivalent chromium (Cr III) compounds are not usually considered health hazards; chromium is an essential trace mineral. However, hexavalent chromium (Cr VI) compounds can be toxic if orally ingested or inhaled. See 5.17.5.2.
Lead – Pb	Lead is used in building construction, lead-acid batteries, bullets and shot, weights for model railroad cars, and is part of solder, pewter, and fusible alloys. Lead is also often used as a pigment in paint.	Lead is a potent neurotoxin which accumulates in soft tissues and bone over time. Lead is a poisonous metal that can damage nervous connections (especially in young children) and cause blood and brain disorders. Long term exposure to lead or its salts (especially soluble salts or the strong oxidant PbO2) can cause nephropathy. The concern about lead's role in cognitive deficits in children has brought about widespread reduction in its use (lead exposure has been linked to schizophrenia).
Mercury – Hg	Mercury occurs in deposits throughout the world and it is harmless in an insoluble form, such as mercuric sulphide, but it is poisonous in soluble forms such as mercuric chloride or methylmercury.	Metallic mercury can be biologically transformed into the organic methylmercury, which means that all release of the metal is potentially dangerous. Mercury and most of its compounds are extremely toxic and are generally handled with care; CAS RNs® of spills involving mercury (such as from certain thermometers or fluorescent light bulbs) specific cleaning instructions should be used to avoid toxic exposure.

Table 11 *(continued)*

Metals	General	Potential risks
Nickel – Ni		Exposure to nickel metal and soluble compounds is strictly controlled. Nickel sulphide fume and dust is believed to be carcinogenic, and various other nickel compounds might be as well.
Selenium – Se	The greatest use of selenium compounds is in electronic and photocopier components, but they are also widely used in glass, pigments, rubber, metal alloys, textiles, petroleum, medical therapeutic agents and photographic emulsions	The substance is irritating to the eyes and the respiratory tract inhalation of dust might cause lung oedema. Inhalation of fume might cause symptoms of asphyxiation, chills and fever and bronchitis. The effects might be delayed. Repeated or prolonged contact with the skin might cause dermatitis. The substance might have effects on the respiratory tract, gastrointestinal tract and skin. Resulting in nausea, vomiting, cough, yellowish skin discolouration, loss of nails, garlic breath and bad teeth.
Zinc – Zn	Zinc is currently used in plating of metallic components.	Even though zinc is an essential requirement for a healthy body, too much zinc can be harmful. Excessive absorption of zinc can also suppress copper and iron absorption. The free zinc ion in solution is highly toxic to plants, invertebrates, and even vertebrate fish.

5.17.4 Test methods

The content of heavy metals can be tested with one of the following test methods:

— Leather: ISO 17072-1 or ISO 17072-2

— Textile: EN 16711-1, EN 16711-2 and EN 16711-3

— Rubber: ISO 19050

5.17.5 Special cases

5.17.5.1 Cadmium

Cadmium compounds are used as pigments (especially in red, orange, yellow and green); as a stabilizer for PVC; and in fertilizers, biocides and paints. It therefore cannot be excluded that cadmium and its compounds are present in footwear or footwear components.

There appears to be no intentional use of Cadmium but there can be impurities in other chemicals used in the textile production process such as in dyes, pigments or colorants.

Total Cadmium could be tested according to the method described in:

— PVC: EN 1122

5.17.5.2 Total chromium and Chromium VI

Chromium is widely used as a leather tanning agent, under its form Chromium III.

Chromium VI can appear in chrome tanned leather due to undesirable chemical reaction, depending on a large amount of parameters (washing of leather, storage conditions, tanning agents, etc.).

In the past, Chromium VI was used for mordant dying process of textile. chromium compounds can be used as dyeing additives, dye-fixing agents, colour fastness after-treatments, dyes for wool, silk and polyamide (especially dark shades). However, the presence of Chromium VI in textile is unlikely.

Cr VI compounds are irritating to eyes, skin and mucous membranes. Chronic exposure to Cr VI compounds can cause permanent eye injury, unless properly treated. Cr VI is an established human carcinogen and allergen.

Chromium VI can be determined directly from leather with ISO 17075-1 (qualitative test) and ISO 17075-2 (quantitative test). An ageing of leather using a specific test method ISO 10195 can be used.

Total chromium (all species of Chromium) could be tested according to the method described in:

— Leather: ISO 17072-2 or ISO 5398-1 and ISO 5398-4

— Textile: EN 16711-1

5.17.5.3 Nickel

Nickel coating are often used for the finishing of metallic pieces. Metallic fastening or ornamental pieces could be used in manufacturing shoes. These components are made with different types of metal or specific alloys. The external finishing for these elements is important in order to give the final desired aspect as brilliant, stained, old style, etc.

This external finishing is reached with different process as burnishing, sandblasting, nickel-plating, etc.

Only metallic pieces in prolonged contact with the skin (eyelet, buckle, side fastener, etc.) are concerned by this document. Sensitized individuals might show an allergy to nickel affecting their skin.

Nickel could be tested according to the method described in EN 1811 or EN 12472.

5.17.5.4 Lead

There may be some intentional use of lead compounds (such as certain lead chromates) in dyes, pigments, colorants . They may also appear as impurities in other chemicals used in the production process. Lead compounds may be associated with plastics, paints, inks, pigments and surface coatings.

Lead is restricted in many countries in the world (European Union and USA).

Lead can be tested according to the method described in:

— Leather: ISO 17072-2.

— Textile: EN 16711-1

5.18 Mercaptobenzothiazole

5.18.1 General

Mercaptobenzothiazole (MBT), see Figure 16, is a substance used in the manufacturing of rubbers (natural or synthetic). It is added to latex or synthetic to improve the vulcanization and to decrease the speed of ageing (ant oxidising agent). Its CAS RN® is 149-30-4. MBT can also be generated by the degradation of TCMBT (see 5.5.2).

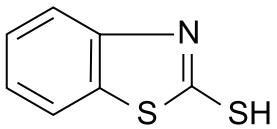


Figure 16 — Mercaptobenzothiazole molecular structure

5.18.2 Potential risks

Mercaptobenzothiazole is an allergen.

5.18.3 Test methods

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

NOTE ISO 13365-1 could be used to determine MBT in footwear and footwear componants.

5.19 N-ethylphenylamine

5.19.1 General

N-ethylphenylamine (N-ethylaminobenzene) is a secondary amine used as an intermediate for dyestuffs. Its CAS RN® is 103-69-5, see Figure 17.

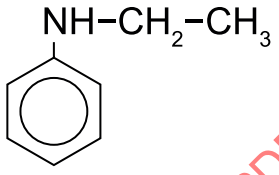


Figure 17 — N-ethylphenylamine molecular structure

5.19.2 Potential risks

It is toxic by inhalation, contact with the skin and if swallowed.

5.19.3 Test methods

No standard is available at the time of publication for N-ethylphenylamine analysis in footwear and footwear components.

5.20 N methyl-2-pyrrolidone (NMP)

5.20.1 General

NMP is used to dissolve a wide range of polymers. It is also used as a solvent for surface treatment of textiles, resins, and metal coated plastics. Its CAS RN® is 872-50-4, see Figure 18.

NMP is used as a solvent in fibre processing (polymer production, yarn spinning) Responses in the Public consultation indicated that NMP can be contained as residual solvent in aramide fibres.

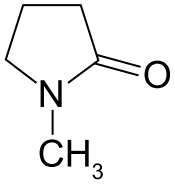


Figure 18 — N-methyl-2-pyrrolidone molecular structure

5.20.2 Potential risks

NMP has a low potential for skin irritation and a moderate potential for eye irritation. No sensitization potential has been observed. NMP is suspected to be carcinogenic.

5.20.3 Test methods

NMP could be tested according to the method described in:

— Leather: ISO 19070

5.21 N,N-dimethylacetamide

5.21.1 General

Dimethylacetamide (DMAC) is commonly used as a solvent for fibres (e.g. polyacrylonitrile) or in the adhesive industry. Its CAS RN® is 127-19-5, see Figure 19.

DMAC is used during the production of elastane/Spandex and acrylic, as a key solvent in wet/dry spinning. Spinning solutions are prepared by dissolving polymer in DMAC, which is extruded through spinnerets to produce elastane fibres. DMAC can be contained, as an impurity, in elastane, aramide and acrylic fibres, PU and PVC coating.

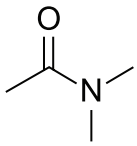


Figure 19 — N,N-dimethylacetamide molecular structure

5.21.2 Potential risks

DMAC is a potency reproductive toxicant (toxic for reproduction, category 1B) and can damage fertility or the unborn child. It is harmful in contact with the skin or if inhaled, and causes serious eye irritation.

5.21.3 Test methods

No standard is available at the time of publication, for N,N-dimethylacetamide analysis in footwear and footwear components. However, DMAC can be determinate together with DMF using ISO 16189.

5.22 Nickel – Ni

See 5.17.

5.23 Nitrosamines

5.23.1 General

Nitrosamines are chemical compounds of the chemical structure $R_1N(-R_2)-N=O$ (see Figure 20), some of which might be carcinogenic. Nitrosamines can be use in rubber products, pesticides and certain cosmetics.

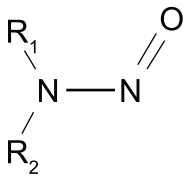


Figure 20 — Nitrosamines molecular structure

See list of the critical nitrosamines in Table 12.

Table 12 — List of critical nitrosamines

Substance		CAS RN®
NDMA	N-nitroso dimethylamine	62-75-9
	N-nitroso methyl-ethylamine	10595-95-6
NDEA	N-nitroso diethylamine	55-18-5
NPYR	N-nitroso pyrrolidine	930-55-2
NMPhA	N-nitroso-N-methylaniline	614-00-6
NMOR	N-nitroso morpholine	59-89-2
NDPA	N-nitroso dipropylamine	621-64-7
NPIP	N-nitroso piperidine	100-75-4
NEPhA	N-nitroso-N-ethylaniline	612-64-6
NDBA	N-nitroso dibutylamine	924-16-3
	N-nitroso-diphenylamine	86-30-6
	N-nitroso dibenzylamine	5336-53-8

5.23.2 Potential risks

Nitrosamines can cause cancers in a wide variety of animal species, a feature that suggests that they might also be carcinogenic in humans. Epidemiological data suggests that nitrosamines in preserved food cause stomach cancer.

These substances should be determined in footwear for children less than 36 months old.

5.23.3 Test methods

The content of nitrosamines can be determined by:

— Footwear: ISO 19577

— Polymers: EN 12868

5.24 Organotins compounds

5.24.1 General

Organotins compounds or stannanes, see Figure 21, are chemical compounds based on tin. Tributyltin oxide (or tributyltin for short) has been extensively used as a wood preservative. Tributyltin compounds are used as marine anti-biofouling agents.

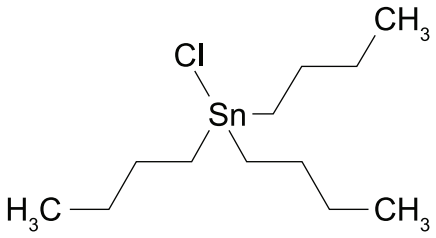


Figure 21 — Example of organotin molecular structure

There are three major applications for organotin compounds. First, the use of tributyltin (TBT) in anti-fouling paints for ships, secondly, the use of triphenyltin (TPhT) as a pesticide, and third, the use of butyl- and octyltin compounds as stabilizers in polymers. Therefore, many textile products containing polymer parts, like T-shirts with prints, sanitary bandages, plasters and diapers can contain organotin compounds. In some occasions organotin compounds are used as fungicides on textiles that are exposed to extreme weather conditions such as canvas.

The following organotins are restricted in the EU under REACH:

— Dibutyltin (DBT) (multiple CAS RNs®)

— Mono-, di- and tri-methyltin derivatives (multiple CAS RNs®)

— Mono-, di- and tri-butyltin derivatives (multiple CAS RNs®)

— Mono-, di- and tri-phenyltin derivatives (multiple CAS RNs®)

— Mono-, di- and tri-octyltin derivatives (multiple CAS RNs®)

5.24.2 Potential risks

Triorganotins are very toxic. Tri-*n*-alkyltins are phytotoxic and therefore cannot be used in agriculture. Depending on the organic groups, they can be powerful bactericides and fungicides. Tributyltins are used as industrial biocides, e.g. as antifungal agents in textiles and paper, wood pulp and paper mill systems, breweries, and industrial cooling systems. Tributyltins are also used in marine anti-fouling paint. Triphenyltins are used as active components of antifungal paints and agricultural fungicides. Other Triorganotins are used as miticides and acaricides.

Diorganotins have no antifungal activity, low toxicity, and low antibacterial activity, except for diphenyltins. They are used in polymer manufacturing, as PVC heat stabilizers, catalysts, in the manufacturing of polyurethane and silicone curing.

Monoorganotins have no biocidal activity and their toxicity to mammals is very low. Methyltin, butyltin, octyltin and monoestertins are used as PVC heat stabilizers.

5.24.3 Test methods

The content of organotins can be tested with the following test methods:

— Footwear: ISO/TS 16179

— Textile: ISO 22744-1 and ISO 22744-2

NOTE It is also possible to assess the possible presence of organotins by a tin screening analysis using ISO 17072-2.

5.25 PAHs (Polycyclic aromatic hydrocarbons)

5.25.1 General

The polycyclic aromatic hydrocarbons (PAH), see Figure 22, include some 100 different substances. They share a similar molecular structure, as they are all compounds with two or more condensed aromatic hydrocarbon rings, such as naphthalene, anthracene, chrysene, or benzo(a)pyrene (see Table 13).

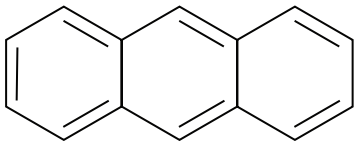


Figure 22 — Example of PAH structure, Anthracene

PAHs are natural components of crude oil and are common residues from refining. PAHs have a characteristic smell similar to that car tires or asphalt. Oil residues containing PAHs have added to rubber and plastics as a softener or extender and can be found in rubber, plastics, lacquers and coating. PAHs are often found in the outsole of footwear and in printing pastes for screen prints. PAHs can be present as impurities in carbon black. They can also be formed from thermal decomposition of recycle materials during reprocessing.

Table 13 — List of Polycyclic aromatic hydrocarbons

Substances	CAS RN®	Substances	CAS RN®
Acenaphtene	83-32-9	BENZO[A]ANTHRACENE	56-55-3
AcenaphTylene	208-96-8	BENZO[A]PYRENE	50-32-8
Anthracène	120-12-7	BENZO[B]FLUORANTHENE	205-99-2
Benzo(g,h,i)perylene	191-24-2	BENZO[E]PYRENE	192-97-2
Fluorene	206-44-0	BENZO[J]FLUORANTHENE	205-82-3
Indeno(1,2,3-cd)pyrere	193-39-5	BENZO[K]FLUORANTHENE	207-08-9
naphtalene	91-20-3	CHRYSENE	218-01-9
phenanthrene	85-01-8	DIBENZO[A,H]ANTHRACENE	53-70-3
pyrene	129-00-0	FLUORENE	86-73-7

NOTE 1 The US EPA (Environmental Protection Agency) has classified 16 PAH as primary pollutants: naphthalene, acenaphtylene, acenaphthene, fluorine, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a) anthracene, chrysene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno[1,2,3-c,d]perylene.

NOTE 2 The German committee for technical work equipment and consumer products decided in November 2007 to include PAH testing in the conditions for awarding the GS mark introduced in 1977. The reason for this additional testing lies in the possibility of PAH contamination by plasticiser oils in rubber and flexible plastics, by lampblack as pigment in rubber and plastics, in paints, and by naphthalene used for preserving products during transport or storage.

5.25.2 Potential risks

These PAH, and above all benzo[a]pyrene, are banned because of their various hormonal, mutagenic, carcinogenic, and fertility-impairing actions. Upon entering the body, they accumulate in adipose tissue, and can even enter through the lungs if they are attached to soot particles. Moreover, PAH might not only be hazardous to health, but might also be extremely long-lived and ubiquitous. PAH are natural constituents of coal and petroleum, and hence also occur in products made from these raw materials such as tar, bitumen, or asphalt. They also admixed with plastics as additives in order to improve their properties. And they arise on combustion of organic materials such as wood or tobacco. Use of combustion residues as low-cost colorants inevitably introduces PAH into the corresponding products.

5.25.3 Test methods

The content of PAHs can be tested with the following test methods:

— Footwear: ISO/TS 16190

— Textile: EN 17132

— Rubber: AfPS GS 2014:01 PAK

5.26 Paraphenylene diamine

5.26.1 General

Para-ethylene-diamine or p-phenylenediamine (PPD) is an aromatic amine compound, with formula $C_6H_8N_2$ or $C_6H_4(NH_2)_2$, and with CAS RN® 106-50-3, see Figure 23.

Para-ethylene-diamine is used with dyes in leather and textile industries.

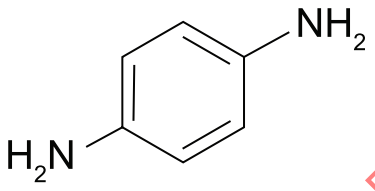


Figure 23 — Paraphenylene diamine molecular structure

5.26.2 Potential risks

The substance can be irritating for the eyes. Inhalation of dust can cause asthmatic reactions. Swelling of the mouth and throat can be observed following ingestion. The substance can cause effects on the blood, resulting in formation of met haemoglobin. Exposure can result in death.

Repeated or prolonged contact can cause skin sensitization. Repeated or prolonged inhalation exposure can cause asthma. The substance can have effects on the kidneys, resulting in kidney impairment.

5.26.3 Test methods

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

NOTE Paraphenylenediamine can be detected in leather and textile with the test method used for aromatic amines (see 5.3) with adaptations (without dithione reduction).

5.27 Pesticides

5.27.1 General

A pesticide (see Table 14 and Table 15) is a substance or mixture of substances intended for preventing, destroying, repelling, or lessening the damage of any pest. A pesticide can be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant.

5.27.2 Potential risks

Many pesticides can be poisonous to humans.

Table 14 — Pesticides for textiles

Substances	CAS RN®	Substances	CAS RN®
DDT op'	789-02-6	Aldrine	309-00-2
DDT pp'	50-29-3	Dieldrine	60-57-1
DDD op'	72-54-8	Endrine	72-20-3
DDD pp'	72-55-9	Endosulfanes	
DDE		Mirex	2385-85-5
HCH's without Lindane		Toxaphene	8001-35-2
Lindane	58-89-9	Heptachlor	76-44-8
Hexachlorobenzene	118-74-1	Heptachloroepoxide	93-76-5
Carbaryle	63-25-2	2,4-D	94-75-7
Trifluraline	1582-09-8	2,4,5-T	93-76-5
Methoxychlor	72-43-5		

Table 15 — Pesticides for leather

Substances	CAS RN®	Substances	CAS RN®
DDT op'	789-02-6	Dieldrine	60-57-1
DDT pp'	50-29-3	Ethylparathione	56-38-2
DDD op'	72-54-8	Endosulfanes	
DDD pp'	72-55-9	Mirex	2385-85-5
DDE		Dichlofluanide	1085-98-9
HCH's without Lindane		Heptachloroepoxide	93-76-5
Lindane	58-89-9	Pentachloroanisole	1825-21-4
Malathione	121-75-5	Permethrine	52645-53-1
Methoxychlor	72-43-5	Tolyfluanide	731-27-1
Aldrine	309-00-2	Chlorthalonil	1897-45-6

5.27.3 Test methods

The content of pesticides can be tested with the following test method:

— Leather: ISO 22517

5.28 Perfluorinated and polyfluorinated chemicals-PFC

5.28.1 Different substances

5.28.1.1 Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA)

Perfluorooctanoic acid (PFOA), also known as C8, is an artificial acid that has many industrial uses. PFOA can designate the acid itself or its principal salts (like ammonium perfluorooctanoate). Perfluorooctane sulfonate is a related compound, used as a surfactant, see Figure 24.

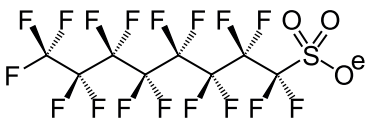


Figure 24a — PFOS molecular structure CAS RN® 2795-39-3

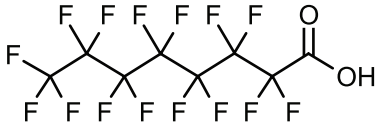


Figure 24b — PFOA molecular structure CAS RN® 3825-26-1

Perfluorooctane sulfonate (PFOS, or perfluorooctanyl sulfonate) is the anion with the formula $C_8F_{17}SO_3^-$. It is the conjugate base of perfluorooctane sulfonic acid. Salts of this anion are used as surfactants.

PFOS are possibly only used in certain parts, or in the coating of, certain products, such as textiles, and only the use of specific octanesulphonates is forbidden.

PFOS are substances that can be degraded only with difficulty in the environment, are accumulative, and are toxic to mammals according to an Organization for Economic Cooperation and Development (OECD) study dating from 2002. Risk assessment has established the necessity of reducing the risk to human health and danger to the environment posed to PFOS.

PFOS belongs to the perfluorinated surfactants. Perfluorinated surfactants are very stable towards chemicals and heat and also towards light (UV radiation). They have excellent dirt, oil and water repelling properties. Compound derived from perfluorooctanesulphonate (PFOS), therefore, have numerous applications in the surface finishing of packaging materials, carpets, textiles, leather and furniture. Polymeric compounds are often used for such applications, they are chemically firmly bonded to the substrate (e.g. to the fibers of a carpet) to prevent washing out. Perfluorinated surfactants are also found in cosmetics, paints, plant protection agents, and fire extinguishers.

PFOS are organic surfactants in which all the hydrogen atoms attached to the carbon skeleton have been replaced by fluorine atoms. This leads to highly stable molecules that can be strongly bio accumulative and toxic. The chemical bond between fluorine and carbon number is one of the most stable bonds known. Certain polyfluorinated compounds such as PFOS are practically indestructible.

PFOS do not occur naturally. Owing to their special properties they are produced industrially and used in a wide range of products.

There is a general ban against the use of substances containing the PFOS sub-component C8F17SO2X, where *x*=all kinds of derivative including polymers. There are discussions about similar regulations for PFOA and substances degrading to PFOA, but so far restrictions in force only for some countries such as Canada.

NOTE Since 2002, German chemical companies have ceased to produce PFOS anywhere in the world.

5.28.1.2 Other PFC

See list of the critical PFCs in Table 16. Other PFCs can be also requested see Table 17.

Table 16 — List of critical PFCs

No	Chemicals		CAS RN®
I. Perfluorinated carboxylic acids			
1	PFHxA	Perfluoro-n-hexanoic acid	307-24-4
2	PFOA	Perfluoro-n-octanoic acid	335-67-1

Table 16 *(continued)*

No	Chemicals		CAS RN®
2.2	APFO	Perfluoro-n-octanoic salts* Ammonium pentadecafluorooctanoate	3825-26-1
	Na-PFO	Sodiumperfluorooctanoate	335-95-5
	K-PFO	Potassium perfluorooctanoate	2395-00-8
	Ag-PFO	Silverperfluorooctanoate	335-93-3
	F-PFO	Perfluorooctanoylfluoride	335-60-0
3	8:2 FTS	1H,1H,2H,2H-Perfluorodecanesulfonic acid	39108-34-4
4	Me-PFOA	Methyl perfluorooctanoate	376-27-2
5	Et-PFOA	Ethyl perfluorooctanoate	3108-24-5
6	PFNA	Perfluoro-n-nonanoic acid	375-95-1
7	PFDA	Perfluoro-n-decanoic acid	335-76-2
8	PFUnA	Perfluoroundecanoic acid	2058-94-8
9	PFDoA	Perfluorododecanoic acid	307-55-1
10	PFTrA	Perfluorotridecanoic acid	72629-94-8
11	PFTeA	Perfluorotetradecanoic acid	376-06-7
12	PF-3,7-DMOA	Perfluoro(3,7-dimethyloctanoic acid)	172155-07-6
13	4HPFUnA	2H,2H,3H,3H-Heptadecafluoroundecanoic Acid	34598-33-9
II. Perfluorinated sulfonic acids			
14	PFBS	Perfluorobutanesulfonic acid	375-73-5
15	PFHxS	Perfluorohexanesulfonic acid	355-46-4
16	PFOS	Perfluoro octanesulfonic acid	1763-23-1
16.2	PFOS-X	Perfluorooctane sulfonic acid salts* $C_8F_{17}SO_2X$	2795-39-3
		— potassium Perfluorooctane sulfonate	29457-72-5
		— lithium Perfluorooctanesulfonate	29081-56-9
		— ammonium Perfluorooctane sulfonate	
		— bis2(hydroxyethyl)ammonium perfluorooctanesulfonate	70225-14-8
		— tetraethyl ammonium heptadecafluorooctanesulfonate	56773-42-3
III. Perfluoro-octanesulfonamides (FOSA)			
17	PFOSA	Perfluorooctane sulfonamide	754-91-6
18	N-MeFOSA	N-Methylperfluoro-1-octanesulfonamide	31506-32-8
19	N-EtFOSA	N-Ethylperfluoro-1-octanesulfonamide	4151-50-2
IV. Perfluoro-octanesulfonamido ethanol (FOSE)			
20	N-MeFOSE	2-(N-methylperlfuoro-1-octanesulfonamideo)-ethanol	24448-09-7
21	N-EtFOSE	2-(N-Ethylperfluoro-1-octanesulfonamido)-ethanol	1691-99-2
V. Fluorinated telomer alcohols (FTOH)			
22	8:2 FTOH	2-Perfluorooctylethanol	678-39-7
VI. Fluorinated telomer acrylate (FTA)			
23	8:2 FTA	1H,1H,2H,2H-Perfluorodecyl acrylate	27905-45-9
VII. Others			
24	PFOSF	Heptadecafluorooctanesulfonyl fluoride	307-35-7
25	8:2 FTMA	1H,1H,2H,2H-heptadecafluorodecylmethacrylate	1996-88-9

Table 16 *(continued)*

No	Chemicals		CAS RN®
26		1-decanaminium, N-decyl-N, N dimethyl-,1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptade- cafluoro-1-octanesulfonate	251099-16-8

Table 17 — List of critical non-regulated PFCs

No	Chemicals		CAS RN®
I. Perfluorinated carboxylic acids			
1	PFBA	Perfluorobutanoic acid	375-22-4
2	PFPeA	Perfluoropentanoic acid	2706-90-3
3	PFHpA	Perfluoro-n-heptanoic acid	375-85-9
II. Perfluorinated sulfonic acids			
4	PFDS	Perfluorodecane Sulfonic Acid	335-77-3
5	PFHpS	Perfluoroheptane sulfonic acid	375-92-8
III. Fluorinated telomer alcohols (FTOH)			
6	4:2 FTOH	2-Perfluorobutylethanol	2043-47-2
7	6:2 FTOH	2-Perfluorohexylethanol	647-42-7
8	10:2 FTOH	2-Perfluorodecylethanol	865-86-1
IV. Fluorinated telomer acrylate (FTA)			
9	6:2 FTA	1H,1H,2H,2H-Perfluorooctyl acrylate	17527-29-6
10	10:2 FTA	1H,1H,2H,2H-Perfluorododecyl acrylate	17741-60-5
V. Others			
11	4:2 FTS	1H,1H,2H,2H-Perfluorohexanesulfonic acid	75124-72-4
12	6:2 FTS	1H,1H,2H,2H-Perfluorooctane sulfonic acid	27619-97-2
13	10:2 FTS	1H,1H,2H,2H-Perfluorododecanesulfonic acid	120226-60-0
14	6:2 FTMA	1H,1H,2H,2H-Perfluorooctylmethacrylate	2144-53-8
15	7HPFHpA	7H-Dodecafluoroheptanoic acid	1546-95-8

5.28.2 Potential risks

PFOS are categorised as possibly carcinogenic to humans. The toxicity of PFOS has been demonstrated, this substance is considered as very persistent and very bio accumulative (vPvB).

5.28.2.1 Test methods

The content of PFOS can be tested with the following test methods:

— PFOS: CEN/TS 15968

— Leather: ISO 23702-1

5.29 pH

5.29.1 General

pH is a measure of the acidity or alkalinity of a solution. The letters “pH” stands for Potential of Hydrogen. Aqueous solutions at 25 °C with a pH less than seven are considered acidic, while those with a pH greater than seven are considered basic (alkaline).

5.29.2 Potential risks

Strong acidic (pH less than 3,2) or strong alkaline pH (higher than 9,5) material can irritate the skin.

5.29.3 Test methods

The content of pH can be tested with one of the following test methods:

— Leather: ISO 4045

— Textile: ISO 3071

5.30 Phenol

5.30.1 General

The major uses of phenol [(CAS RN® 108-95-2) see Figure 25] involve its conversion to plastics or related materials. For example, condensation with formaldehyde gives phenolic resins. Nonionic detergents are produced by alkylation of phenol to give the alkylphenols.

Phenol is also a versatile precursor to a large collection of drugs, many pesticides, etc.

Phenol, see Figure 22, was used in the past as a biocide.

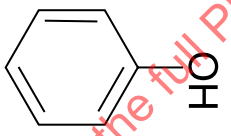


Figure 25 — Phenol structure

5.30.2 Potential risks

Phenol and its vapours are corrosive to the eyes, the skin, and the respiratory tract. Repeated or prolonged skin contact with phenol can cause dermatitis, or even second and third-degree burns due to phenol's caustic and degreasing properties. Inhalation of phenol vapor can cause lung edema. Long-term or repeated exposure of the substance can have harmful effects on the liver and kidneys. There is no evidence to believe that phenol causes cancer in humans.

5.30.3 Test methods

The content of phenol can be tested with the following test method:

— Footwear: ISO 20536

5.31 Phenyl mercury

5.31.1 General

According to EU regulations, the five phenylmercury compounds (see Table 18 and Figure 26) are mainly used as catalysts in the production of polyurethane coatings, adhesives, sealants and elastomers. The mercury catalysts are incorporated into the polymer structure and remain in the final product. The life-cycle of the phenylmercury compounds leads to the release of mercury to the environment and adds to the overall emissions of mercury.

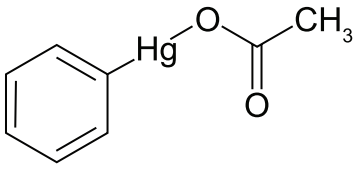


Figure 26 — Example of phenyl mercury component acetate phenylmercury

Table 18 — List of phenylmercury

Substance	CAS RN®
Phenylmercury acetate	62-38-4
Phenylmercury propionate	103-27-5
Phenylmercury 2-ethylhexanoate	13302-00-6
Phenylmercury octanoate	13864-38-5
Phenylmercury neodecanoate	26545-49-3

5.31.2 Potential risks

Mercury and its compounds are highly toxic to humans, ecosystems and wildlife, with mercury toxicity most commonly affecting the neurologic, gastrointestinal and renal organ systems. Poisoning can result from mercury vapor inhalation, mercury ingestion, mercury injection and absorption of mercury through the skin. In particular, the phenylmercury compounds degrade in the environment and result in degradation products including methylmercury. Methylmercury can be considered to be a persistent, bio accumulative and toxic substance (PBTs). The use of mercury and its compounds is heavily regulated in order to eliminate or reduce exposure to mercury and its compounds.

5.31.3 Test methods

No standard is available at the time of publication, for phenyl mercury analysis in footwear and footwear components.

NOTE It is also possible to assess the possible presence of phenylmercury by a mercury screening analysis using ISO 17072-2.

5.32 Phthalates

5.32.1 General

Phthalates (see Figure 27), or phthalate esters, are a group of chemical compounds that are mainly used as plasticizers (substances added to plastics to increase their flexibility). They are chiefly used to turn polyvinyl chloride from a hard plastic into a flexible plastic.

Phthalate esters are the dialkyl or alkyl aryl esters of 1,2-benzenedicarboxylic acid; the name 'phthalate' derives from phthalic acid. When added to plastics, phthalates allow the long polyvinyl molecules to slide against one another. The phthalates show low water solubility, high oil solubility, and low volatility.