



BSI Standards Publication

**Textiles and textile products
— Guidance on health and
environmental issues related
to chemical content of textile
products intended for clothing,
interior textiles and upholstery**

4.1.3 Regulation/Specific tests method

Based on several regulations (national or regional), the textile parts of the product should not contain formaldehyde which can be released in quantities higher than a limit determined between 16 to 300 ppm (in relation to the concerned country, indicative values according to EN ISO 14184-1 (free and hydrolised formaldehyde) or EN ISO 14184-2 (released formaldehyde) or technically identical test method).

The limits should be fixed at lower levels in the case of babies and infants in comparison with adults.

Sources (non-exhaustive list): legislations from Austria, Germany, South Korea, Finland, Norway, Netherlands, Japan, China / European decision: EU Commission Decision 2014/350/EC of 5 July 2014 establishing the ecological criteria for the award of the EU Ecolabel for textile products.

Test methods: EN ISO 14184-1 and EN ISO 14184-2

4.2 Chlorophenols (pentachlorophenol, isomers of tetrachlorophenol)

4.2.1 General

Pentachlorophenol (PCP) is a synthetic substance that was first produced in the 1930s. It can be found in two forms: PCP itself or as the sodium salt of PCP, which dissolves easily in water. In the past, it has been used as a herbicide, insecticide, fungicide, algacide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds (for non-food uses), leather, masonry, wood, cooling tower water, rope and paper mill system.

TeCP is often used to replace the PCP.

4.2.2 Why is PCP a critical substance?

Short-term exposure to large amounts of PCP can cause harmful effects on the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. Contact with PCP (particularly in the form of vapour) can irritate the skin, eyes, and mouth. Long-term exposure to low levels such as those that occur in the workplace can cause damage to the liver, kidneys, blood, and nervous system. Finally exposure to PCP is also associated with carcinogenic, renal, and neurological effects.

PCP is classified in the group of probable human carcinogen.

4.2.3 Regulation/Specific tests method

PCP (CAS No 87-86-5) is restricted under the EU REACH Regulation (EC) n°1907/2006, Annex XVII. PCP shall not be placed on the market, or used, as a substance or as a constituent in other substances, or mixtures, in a concentration equal to or greater than 0,1 % by weight.

PCP is regulated in Austria, Denmark, Germany, Netherlands, Norway, Poland and Switzerland and by many ecological labels in textile and leather products (not detected – 5ppm depending on countries and type of products).

TeCP is regulated only in Switzerland (not detected) but also by many ecological labels (0,05 ppm – 5 ppm).

Based on regulation or some ecological labels, the textile parts of the product should not contain chlorophenols, such as pentachlorophenol, tetrachlorophenol, which can be released in quantities higher than a limit determined between 0,05 ppm to 5 ppm (in relation to the concerned country).

Sources: regulations from European Union, European decision: European Ecolabel for textile products.

Test methods: no European standardized method available for textiles (some are national such as XP G08-015 – France, UNI 11057 — Italy), EN ISO 17070 for leather.

4.3 Orthophenylphenol (OPP)

4.3.1 General

2-Phenylphenol, or *o*-phenylphenol, 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. 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, dyestuffs, resins and rubber chemicals.

The sodium salt of ortho-phenylphenol, sodium ortho-phenylphenol, is used as a preservative.

4.3.2 Why is it a critical substance?

Eye contact can cause severe irritation and burns with possible eye damage. For some individuals, 2-phenylphenol can also irritate the skin. It is one of the chemicals that the Hyperactive Children's Support Group recommends be eliminated from the diet of children.

4.3.3 Tests method

Some laboratories use the same method as for PCPs (i.e. EN ISO 17070).

The only known limits are the ones proposed by one ecological label: 50ppm for baby clothes; 100 ppm for others.

Test methods: no European standardized method available for textiles, EN ISO 17070 for leather.

4.4 Heavy metals

4.4.1 General

Toxic effects of heavy metals on human health are very well known. Once absorbed by humans, heavy metals tend to accumulate in internal organs such as the liver or kidney. The effects on health can be tremendous when high levels of accumulation are reached, damages of organs, disorders in the respiratory tract and lung diseases, dysfunction of the heart, blood and blood producing organs, skin diseases and some others. Children tend to absorb the heavy metals more than the adults, which put them to higher risk of health problem.

Metals may be introduced into textiles through dyeing and finishing processes. They are constituents of some dyes and pigments. Sometimes, natural fibres (like cotton, flax and hemp) also have traces of heavy metals, which are absorbed by the plants from the artificial fertilizers through soil.

For the metal determination, it is possible to follow two different approaches:

Due to the toxicity of some heavy metals, guidelines for tolerable amounts of these metals in textile products have been provided and are being adopted by countries and/or companies all over the world.

Heavy metals very often referred in companies' specifications and ecological labels are: Antimony (Sb), Arsenic (As), Lead (Pb), Cadmium (Cd), Mercury (Hg), Copper (Cu), Total Chromium, Chromium (Cr) VI, Cobalt (Co) and Nickel (Ni).

Despite heavy metals' toxicity is well known, only a few heavy metals are legislated on articles. Some metals are restricted under the EU REACH Regulation (EC) n°1907/2006, Annex XVII and this restriction are for textiles articles or articles that can be used as accessories in textiles articles.

Table 4 — Regulation and Specific test methods related to Antimony

Metal	Regulation	Test method	Material	Maximum allowed
Extractable Antimony	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	Toys	Category III (mg/kg) 560
Extractable Antimony	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	bed mattresses	0,5 mg/kg

4.4.5 Arsenic – As

4.4.5.1 General

Arsenic is a chemical element with the symbol As and the atomic number 33. This is a notoriously poisonous metalloid but it is more commonly found as arsenide and arsenate compounds.

Arsenic has had several major industrial uses as an essential component of animal feed (to promote growth), herbicides and pesticides, defoliant, lead batteries, metal alloys, semiconductors, wood preservatives, as well as glass manufacturing.

4.4.5.2 Why is it a critical substance?

Arsenic and many of its compounds are especially potent poisons. Arsenic disrupts ATP production through several mechanisms. Elemental arsenic and arsenic compounds are classified as "toxic" and "dangerous for the environment" in EU directive n°67/548/EEC.

4.4.5.3 Regulation/Specific tests method

Table 5 summarizes the information related to regulation and test methods.

Table 5 — Regulation and specific tests method related to arsenic

Metal	Regulation	Test method	Material	Maximum allowed
Extractable arsenic	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	Toys	Category III (mg/kg) 47
Extractable arsenic	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	bed mattresses	0,5 mg/kg
Total arsenic	EU REACH Regulation (EC) n°1907/2006 of the European parliament and of the council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), Annex XVII: Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles 19. Arsenic compounds	—	preservation of wood	Not used

4.4.6 Barium – Ba

4.4.6.1 General

Barium is a chemical element with the symbol Ba, and atomic number 56. Barium is a soft silvery alkaline earth metal. The most important compounds are the peroxide (BaO₂), chloride, sulfate, carbonate, nitrate, and chlorate. Lithopone, a pigment containing barium sulfate and zinc sulfide, has good covering power, and does not darken in the presence of sulfides. The sulfate, as permanent white or blanc fixe, is also used in paint, in X-ray diagnostic work, and in glassmaking. Barite is extensively used as a weighting agent in oilwell drilling fluids, and also in making rubber. The carbonate has been used as a rat poison, while the nitrate and chlorate give colours in pyrotechnic.

4.4.6.2 Why is it a critical substance?

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, dyspnea and paralysis.

Table 7 — Regulation and specific tests method related to cadmium

Metal	Regulation	Test method	Material	Maximum allowed
Extractable cadmium	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	Toys	Category III (mg/kg) 17
Total cadmium	EU REACH Regulation (EC) n°1907/2006 of the European parliament and of the council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), Point 23 of the Annex XVII:Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles	EN 1122	Plastics	0,01 %
Extractable cadmium	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	bed mattresses	0,1 mg/kg
Total cadmium	European Ecological Criteria for Footwear 2009/563/EC	EN 14602	Leather and leather base material	100 mg/kg

The ongoing European ecological footwear criteria were laid down initially by Commission Decision of 1999/179/EC and 2002/231/EC. Their related assessments and verification requirements remain applicable until 31 March 2010. The applicable period of new Decision 2009/563/EC, is valid until 30 December 2015.

4.4.8 Chromium – Cr

4.4.8.1 General

Chromium is a chemical element in the periodic table with the symbol Cr and atomic number 24. It is a steel-gray, lustrous, hard metal that takes a high polish and has a high melting point. It is also odourless, tasteless, and malleable.

Chromium compounds are used in dyes and paints, plating of metallic components and the tanning of leather.

In the past, Chromium VI was used for mordant dyeing process of textile. Both Cr III and Cr VI, as oxidation states, may occur in the textile processes.

4.4.8.2 Why is it a critical substance?

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. Most 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.

4.4.8.3 Regulation/Specific tests method

Table 8 summarizes the information related to regulation and test methods.

Table 8 — Regulation and specific tests method related to chromium

Metal	Regulation	Test method	Material	Maximum allowed
Extractable chromium (total)	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	Bed mattress	1,0 mg/kg
Extractable chromium (total)	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	toys	Category III (mg/kg) Cr (III) 460 Cr (VI) 0,2
Total chromium		EN ISO 5398-1 EN ISO 5398-3 EN ISO 5398-4	leather	
Cr VI	EU Regulation n°301/2014 (related to REACH restriction in Annex XVII, entry 47)	EN ISO 17075	leather	3 mg/kg

4.4.9 Cobalt – Co

4.4.9.1 General

Cobalt is a hard, lustrous, silver-grey metal, a chemical element with symbol Co. It is found in various ores, and is used in the preparation of magnetic, wear-resistant, and high-strength alloys. Its compounds are as catalysts for the petroleum and chemical industries, as drying agents in paints, de-colourizers, dyes, pigments, and oxidizers. Cobalt blue is an important part of artists' palette and is used by craft workers in porcelain, pottery, stained glass, tiles and enamel jewellery.

4.4.9.2 Why is it a critical substance?

Cobalt compounds should be handled with care due to cobalt's slight toxicity. Cobalt is known as an allergenic substance that can cause dermatitis (contact allergy).

Cobalt is beneficial for humans because it is a part of vitamin B12, which is essential for human health. Cobalt is used to treat anaemia with pregnant women, because it stimulates the production of red blood cells. The total daily intake of cobalt is variable and may be as much as 1 mg, but almost all will pass through the body unabsorbed, except that in vitamin B12. However, too high concentrations of cobalt may damage human health. When breathing too high concentrations of cobalt through air in, lung effects are experienced (such as asthma and pneumonia). This mainly occurs with people that work with cobalt.

When plants grow on contaminated soils they will accumulate very small particles of cobalt, especially in the parts of the plant we eat, such as fruits and seeds. Soils near mining and melting facilities may contain very high amounts of cobalt, so that the uptake by humans through eating plants can cause health effects.

Health effects that are a result of the uptake of high concentrations of cobalt are:

- vomiting and nausea;
- vision problems;
- heart problems;
- thyroid damage.

4.4.9.3 Regulation/Specific tests method

Table 9 summarizes the information related to regulation and test methods.

Table 9 — Regulation and specific tests method related to cobalt

Metal	Regulation	Test method	Material	Maximum allowed
Extractable cobalt	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	toys	Category III (mg/kg) 130
Extractable cobalt	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	Bed mattress	0,5 mg/kg

4.4.10 Copper – Cu

4.4.10.1 General

Copper is a chemical element in the periodic table with the symbol Cu and atomic number 29. It is a ductile metal with excellent electrical conductivity, and finds extensive use as for example for artwork and jewellery around the world.

Copper compounds are used to preserve wood and as leather tanning chemicals and mordant (fixative) in textile dyeing.

Cuprous Chloride, which is insoluble in water, is used as a heat and light stabilizer for polyamide and as a catalyst for chemical synthesis.

Copper is used as a raw material for phthalocyanine blue pigments; Copper sulfate is used as a fungicide on crops, as a pesticide to kill snails and slugs, and as water treatment to kill aquatic vegetation. This chemical has serious chronic toxicity with implications for agricultural workers and the environment.

Copper is an essential trace nutrient to all high plants and animals. Just as some copper is essential for good health, too much can be harmful.

4.4.10.2 Why is it a critical substance?

A healthy human can excrete some excess copper. However, high doses, long-term exposure, and certain routes of exposure can overwhelm the biological processes that excrete excess copper from the body.

Large doses of copper-containing compounds, such as copper sulfate, are poisonous even to those with a healthy liver. However, some people are at greater risk of copper toxicity. People with certain liver diseases and those with an inherited inability to metabolize copper are particularly sensitive to copper toxicity, such as people with Menkes disease, hereditary aceruloplasminemia, and Wilson's disease.

4.4.10.3 Regulation/Specific tests method

Table 10 summarizes the information related to regulation and test methods.

Table 10 — Regulation and specific tests method related to copper

Metal	Regulation	Test method	Material	Maximum allowed
Extractable copper	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	toys	Category III (mg/kg) 7 700
Extractable copper	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	bed mattresses	2,0 mg/kg

4.4.11 Lead – Pb

4.4.11.1 General

Lead is a chemical element in the periodic table with the symbol Pb and atomic number 82.

A soft, heavy, toxic and malleable poor metal, lead is bluish white when freshly cut but tarnishes to dull gray when exposed to air. Lead can be used as a pure metal, alloyed with other metals, or as a chemical compound. The uses of lead are several for example: White lead, lead sulfate and lead chromate are used as colouring elements in paints and ceramic glazes, notably in the colours red and yellow. It is commonly used in polyvinyl chloride (PVC) plastic that covers electrical cords. It is used to form glazing bars for stained glass or other multi-lit windows. Lead sheets are used in the construction industry for weathering, roofing and cladding, to prevent water penetration. It is also used for the lining of chemical treatment baths, acid plants and storage vessels. By the virtue of its high density, lead sheet is used for sound insulation and radiation shielding. Some other applications of lead include the making of leaded bronze ornaments, toys, bullets and shot, lead weights and coffins.

4.4.11.2 Why is it a critical substance?

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).

4.4.11.3 Regulation/Specific tests method

Table 11 summarizes the information related to regulation and test methods.

Table 11 — Regulation and specific tests method related to lead

Metal	Regulation	Test method	Material	Maximum allowed
Extractable lead	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	Bed mattress	0,5 mg/kg
Extractable lead	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	Toy	Category III (mg/kg) 160
Total lead	Commission Decision 2009/563/EC of 28 July 2009 establishing the ecological criteria for the award of the European Ecolabel for footwear	EN 14602	footwear	100 mg/kg
Total lead	US under the Consumer Product Safety Improvement Act (CPSIA)	CPSC-CH-E1003-09 ASTM E 1645-01	Paint and similar coating material	90 mg/kg
Total lead	US under the Consumer Product Safety Improvement Act (CPSIA)	CPSC-CH-E1001-08	Children's Metal Products (Including Children's Metal Jewellery)	(300) 100 mg/kg after 08/2011
Total lead	US under the Consumer Product Safety Improvement Act (CPSIA)	CPSC-CH-E1002-08	Non-Metal Children's Products	(300) 100 mg/kg after 08/2011
Total lead	EU REACH Regulation (EC) n°1907/2006 of the European parliament and of the council of 18 December 2006 concerning the Registration, Evaluation, Authorization and		Paint	

Metal	Regulation	Test method	Material	Maximum allowed
	Restriction of Chemicals (REACH), Annex XVII:Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles (point 16)			

4.4.12 Mercury – Hg

4.4.12.1 General

Mercury is a chemical element in the periodic table with the symbol Hg and atomic number 80. A heavy, silvery transition metal, mercury is one of five elements that are liquid at or near room temperature and pressure.

Major uses of mercury include dental amalgams, tilt switches, thermometers, lamps, pigments, batteries, reagents, and barometers. In cosmetic, some skin whitening products contain the toxic chemical mercury (II) chloride as the active ingredient. The mercury-based preservative thiomersal has been added to vaccines since the 1930s to prevent their deterioration. With the exception of some flu vaccines, it is no longer used as a preservative in routinely recommended childhood vaccines in the United States; it is still in limited use as a preservative in multi-dose flu and tetanus vaccines and a few other non-childhood vaccines. Organic mercury compounds found extensive use in agriculture as plant and seed protectors and in industry as preservatives and antimicrobial agents.

4.4.12.2 Why is it a critical substance?

Mercury may cause many harmful effects on the nervous, digestive and respiratory systems, and the kidneys, and can cause an allergic skin reaction, and is a reproductive hazard.

4.4.12.3 Regulation/Tests methods

Table 12 summarizes the information related to regulation and test methods.

Table 12 — Regulation and specific tests method related to mercury

Metal	Regulation	Test method	Material	Maximum allowed
Extractable mercury	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3		0,02 mg/kg
Extractable mercury	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	Toys	Category III (mg/kg) 94

Nickel is used in many industrial and consumer products, including stainless steel, magnets, coinage, rechargeable batteries, electric guitar strings and special alloys. It is also used for plating and as a green tint in glass. Nickel is pre-eminently an alloy metal, and its chief use is in the nickel steels and nickel cast irons, of which there are many varieties. It is also widely used in many other alloys, such as nickel brasses and bronzes, and alloys with copper, chromium, aluminium, lead, cobalt, silver, and gold.

It can be used in clothing accessories: clasps, buckles, jeans' buttons, zips, bra hooks, metallic gloves, suspenders, glasses' frame, shoe eyelets, hair pins, snap fasteners, reinforcement for safety shoes. Jewellery: needles used for ear piercing or other piercings, earrings, bracelets, watches, brooches, neck chains, necklaces, pendants...

We can also find uses in galvanization industry, in dyes, stains for paper and paint, stain and colouring agents for ceramics, ceramic and glass, colorant for oils, enamel paint: yellow (nickel phosphate), green (nickel oxide), printing and dye for certain textiles, catalyst and reactant for the plastic industry, etc...

In textile industry we can find machinery made of nickel like for example textile rotary nickel screen that can contribute to high nickel content in printed textiles.

4.4.13.2 Why is it a critical substance?

Routes of nickel intake for man and animals are inhalation, ingestion and percutaneous absorption. The pulmonary absorption of nickel compounds varies according to chemical and physical form, with insoluble compounds generally being cleared more slowly. Gastrointestinal intake of nickel by man is relatively high ranging from 300 to 500 µg daily; however, absorption is low, averaging one to 10 percent of intake.

Nickel is an important cause of contact allergy, partly due to its use in jewellery intended for pierced ears. Nickel allergies affecting pierced ears are often marked by itchy, red skin. Many earrings are now made "nickel-free" due to this problem. The amount of nickel which is allowed in products which come into contact with human skin is regulated by the European Union.

4.4.13.3 Regulation/ tests method

Table 13 summarizes the information related to regulation and test methods.

Table 13 — Regulation and specific tests method related to nickel

Metal	Regulation	Test method	Material	Maximum allowed
Extractable nickel	Council Directive 88/378/EEC of 3 May 1988 substituted by EU Toy safety directive (EC) n°48/2009 (Part III of the Annex II)	EN 71-3	Toys	Category III (mg/kg) 930
Extractable nickel	Commission Decision 2009/598/EC of 9 July 2009 establishing the ecological criteria for the award of the European Ecolabel for bed mattresses	DIN 54233-3	bed mattresses	1,0 mg/kg
Extractable nickel	EU REACH Regulation (EC) n°1907/2006 of the European parliament and of the council of 18	EN 1811 EN 12472 + EN 1811	(a) in all post assemblies which are inserted into pierced ears and	0,5 µg/cm ² /week

4.5.3 Regulation/Specific test methods

4.5.3.1 Regulation

Based on the European regulation (and other national regulations) the textile articles should not contain certain flame retardant auxiliaries like: Tris (2,3 dibromopropyl) phosphate (TRIS), Tris(aziridinyl)phosphin oxide (TEPA), Polybromobiphenyls (PBB), Diphenylether, pentabromo derivative $C_{12}H_5Br_5O$ and Diphenylether, octabromo derivative $C_{12}H_2Br_8O$

4.5.3.2 Test method

At the moment, there is no standardized test method regarding the Flame Retardants testing.

Recommended method: extraction of the Flame Retardant agents with an appropriate solvent and control by chromatography.

Under preparation: EN ISO 17881-1 (brominated), EN ISO 17881-2 (phosphorus) and EN ISO 17881-3 (chlorinated paraffin).

Limit: no indication of limit

Regulatory Source:

EU REACH Regulation (EC) n°1907/2006 Annex XVII: Restriction on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles.

Entry n°4: Tris (2,3 dibromopropyl) phosphate (TRIS) CAS n°126-72-7,

Entry n°7: Tris(aziridinyl)phosphin oxide (CAS n°5455-55-1),

Entry n°8: Polybromobiphenyls (PBB) (CAS n°59536-65-1)

shall not be used in textile articles, e.g. garments, undergarments and linen, intended to come into contact with the skin.

EU Regulation n°850-2004:

Diphenylether, pentabromo derivative $C_{12}H_5Br_5O$ (CAS n°32534-81-9) and Diphenylether, octabromo derivative $C_{12}H_2Br_8O$ (CAS n°32536-52-0)

1. Shall not be placed on the market or used as a substance or as a constituent of preparations in concentrations higher than 0,1 % by mass.

2. Articles may not be placed on the market if they, or flame-retarded parts thereof, contain this substance in concentrations higher than 0,1 % by mass.

4.6 Carcinogenic dyes, suspected dyes and derived substances

4.6.1 General

Since the discovery of the first synthetic dyestuff, thousands of dyes were made and used in the textile industry worldwide.

There are many classes of dye used to colour different types of textile fibre. Some dyes have been found to cause or are suspected of causing health problems.

4.6.2 Carcinogenic amines derived from azo colorants

4.6.2.1 Why are these critical substances?

Azo colorants may release, by reductive cleavage of azo group(s), one or more aromatic amines, some of which are, or are suspected of being, carcinogenic.

Example: Red congo dyes which lead to benzidine after cleavage (see Figure 1):

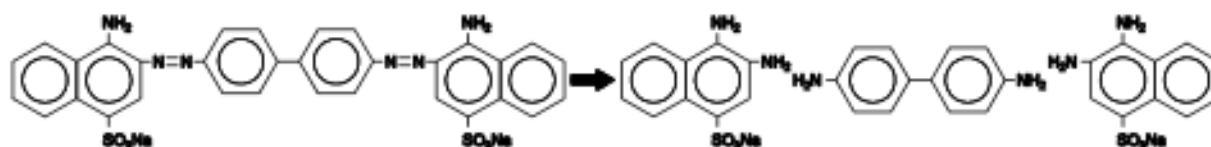


Figure 1 — Cleavage of Red Congo dyes into benzidine

4.6.2.2 Regulation/Specific test methods

EU REACH Regulation (EC) n°1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

Tests methods are EN 14362-1 and EN 14362-3.

4.6.3 Carcinogenic colorants and colorants suspected to be carcinogenic, mutagenic or toxic to reproduction

4.6.3.1 Why are these critical substances?

Some of the dyestuffs were identified as being able to present a risk for the human health: carcinogenic, mutagenic, toxic to reproduction.

4.6.3.2 Regulation/Specific test methods

Based on Ecological criteria for the European Ecolabel for textile products, the textile articles should not contain dyestuffs classified as carcinogenic, mutagenic or toxic to reproduction (see Annex A) or dyestuffs containing substances that are assigned any of the following risk phrases: R40, R45, R46, R49.

Test method: EN ISO 16373-2 and EN ISO 16373-3.

Limit:

— 50 ppm (limit inspired by one ecological label)

Source:

European decision: Commission Decision 2009/567/EC of 9 July 2009 – Ecological criteria for the European Ecolabel for textile products.

Textile parts shall not contain or release colorants which are classified to be carcinogenic or suspected and listed in Table 15.

Limit: 1 mg/kg (limit inspired by some ecological labels)

- Chlorobenzenes
- Chlorotoluenes

Propositions: 0,1 % or 1000 mg/kg (REACH limit)

- Chloroform (CAS No 67-66-3), 1,1,2-Trichloroethane (CAS No 79-00-5), 1,1,2,2-Tetrachloroethane (CAS No 79-34-5), 1,1,1,2-Tetrachloroethane (CAS No 630-20-6), Pentachloroethane (CAS No 76-01-7) and 1,1-Dichloroethene (CAS No 75-35-4) are restricted under the EU REACH Regulation (EC) No 1907/2006, Annex XVII. These substances shall not be placed on the market, or used, as substances, or as constituents of other substances, or in mixtures, in concentrations equal to or greater than 0,1 % by weight, where the substance or mixture is intended for supply to the general public and/or is intended for diffusive applications such as in surface cleaning and cleaning of fabrics.

Sources:

- European Decision 2009/567/EC of 9 July 2009 – Ecological criteria for the European Ecolabel for textile products - Criteria 24. Halogenated carriers for polyester.
- DIN 54232

4.10 Phthalates

4.10.1 General

Phthalates are esters of phthalic acid and are mainly used as plasticisers (substances added to plastics to increase their flexibility, transparency, durability, and longevity).

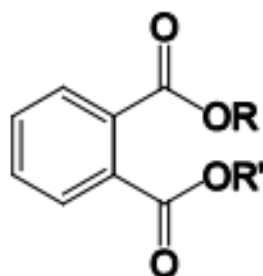


Figure 2 — General chemical description

4.10.2 Why is it critical?

Some phthalates have been found to disrupt the endocrine system. Several phthalate compounds have caused reduced sperm counts, testicular atrophy and structural abnormalities in the reproductive systems of male test animals and some studies also link some phthalates to liver cancer.

4.10.3 Regulations / Specific test method

The EU REACH Regulation (EC) n°1907/2006 Candidate List of Substances of Very High Concern (SVHC) includes phthalates, e.g. Dibutyl phthalate (DBP), Bis (2-ethylhexyl) phthalate (DEHP), Benzylbutyl phthalate (BBP), Diisobutyl phthalate (DIBP). The list of identified substances of very high concern is updated regularly. The current listing can be found at <http://echa.europa.eu/candidate-list-table>.

Uses of some phthalates in the EU require authorization. The list of substances subject to authorization requirement can be reviewed at <http://echa.europa.eu/fi/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list>.

Ecological labels and commercial restrictive substance lists, in addition to these four, also name Di-isononyl phthalate (DINP), Di-isodecyl phthalate (DIDP) and Di-n-octyl phthalate (DNOP). See ECHA report about DINP and DIDP in Bibliography.

Limits:

Dibutyl phthalate (DBP; CAS No 84-74-2), Bis (2-ethylhexyl) phthalate (DEHP; CAS No 117-81-7), Benzyl butyl phthalate (BBP; CAS No 85-68-7), Di-'isononyl' phthalate (DINP; CAS No 28553-12-0 and 68515-48-0), Di-'isodecyl' phthalate (DIDP; CAS No 26761-40-0 and 68515-49-1) and Di-n-octyl phthalate (DNOP; CAS No 117-84-0) are restricted under the EU REACH Regulation (EC) n°1907/2006, Annex XVII.

DBP, DEHP and BBP shall not be used as substances or in mixtures, in concentrations greater than 0,1 % by weight of the plasticised material, in toys and childcare articles. Toys and childcare articles containing these phthalates in a concentration greater than 0,1 % by weight of the plasticised material shall not be placed on the market.

DINP, DIDP and DNOP shall not be used as substances or in mixtures, in concentrations greater than 0,1 % by weight of the plasticised material, in toys and childcare articles which can be placed in the mouth by children. Such toys and childcare articles containing these phthalates in a concentration greater than 0,1 % by weight of the plasticised material shall not be placed on the market.

Test method: EN ISO 14389.

Where the phthalate content is a limited part of a component of the article, it is recommended that only this part of the article be assessed. An average result for the whole article is unacceptable.

4.11 Organotin compounds

4.11.1 General

Organotins compounds have been used in the shipping industry as protective paint coatings applied to ship's hulls. In water, trisubstituted organotin compounds decompose in a stepwise manner to less substituted compounds, down to inorganic tin. They are used in the industry in the form of chloride complexes.

In the textile industry, organotin compounds have been used for preventing the bacterial degradation of sweat and the corresponding unpleasant odour of socks, shoes and sport clothes. Can also be applied to a wide range of textile products like sanitary towels, nappies (diapers), tents, carpets and synthetic clothing (e.g. underwear, socks and sportswear).

Some organotins (mainly mono- and di-organotins) may be used in PVC as heat stabilizers for reducing the polymer degradation during high temperature processing; as catalyst in polymerization of polyurethane, polyester and silicones; as curing catalysts for urethane coatings and polyurethane foam production (the largest use of Dibutyltin); as biocide in the formulations of anti-fouling agents, fungicides, insecticides, and bactericides.

4.11.2 Why is it critical?

The use of organotin compounds in consumer articles has been found to pose a risk to human health, particularly for children. The specific published human health is the possible damage to: liver and kidney organs, disruption of biochemical process such as blood-forming mechanisms and disruption of the enzyme system.

4.11.3 Regulations / Specific test method

For the textile analysis there isn't any developed standard. A modification of the EN ISO 17353 can be used. The textile extraction could be done in an ultrasonic bath with a solution of 5 % of glacial acetic acid in ethanol and sodium diethyldithiocarbamate as a complexing agent.

When analysed by gas chromatography (GC), polar ionic organotin species need to be extracted from the sample matrices and converted into their fully alkylated and more volatile forms by derivatization, which generates sharper peaks and higher sensitivity. The analysis is made more difficult because no derivatized standards are commercially available so they have to be prepared in the laboratory.

NOTE Leather: CEN ISO/ TS 16179, Footwear - Critical substances potentially present in footwear and footwear components – Determination of organotin compounds in footwear materials.

Tri-substituted organostannic compounds such as tributyltin (TBT) compounds and triphenyltin (TPT) compounds shall not be used in articles where the concentration in the article, or part thereof, is greater than the equivalent of 0,1 % by weight of tin.

Dibutyltin (DBT) compounds shall not be used in mixtures and articles for supply to the general public where the concentration in the mixture or the article, or part thereof, is greater than the equivalent of 0,1 % by weight of tin, except for articles, by way of derogation, as fabrics coated with PVC containing DBT compounds as stabilizers when intended for outdoor applications.

Diocetyl tin (DOT) compounds shall not be used in the following articles for supply to, or use by, the general public, where the concentration in the article, or part thereof, is greater than the equivalent of 0,1 % by weight of tin: — textile articles intended to come into contact with the skin, — gloves, — footwear or part of footwear intended to come into contact with the skin, — wall and floor coverings, — childcare articles, — female hygiene products, — nappies, — two-component room temperature vulcanisation moulding kits (RTV-2 moulding kits).

COMMISSION REGULATION (EU) n°276/2010 of 31 March 2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) as regards Annex XVII (dichloromethane, lamp oils and grill lighter fluids and organostannic compounds).

Some organostannic compounds are included in the EU REACH Regulation (EC) n°1907/2006 Candidate List of Substances of Very High Concern (SVHC). The list is regularly updated and the current list can be found at <http://echa.europa.eu/candidate-list-table>.

4.12 Perfluorooctanesulfonates (PFOS) and perfluorooctanoic acid (PFOA)

4.12.1 General

PFOS (perfluorooctanesulfonates $C_8F_{17}SO_2X$; X = OH, Metal salts O-M+, halides, amides and other derivatives including polymers) are manmade perfluorinated tensides.

The major use of PFOS is in the manufacturing process to give grease, stain and water repellence properties to materials. Thus textiles for apparel and upholstery; carpets; paper and packaging; leather; adhesives; and general coatings are examples of goods that maybe treated with PFOS related compounds.

PFOA (perfluorooctanoic acid, $C_8HF_{15}O_2$) is a manmade perfluorinated surfactant. It is mainly used as a surfactant in the emulsion polymerization of fluoropolymers like for PTFE. Thus it is often found in finished textiles containing fluorinated polymers.

4.12.2 Why is it a critical substance?

PFOS are classified as very persistent, very bioaccumulative substances which are toxic to mammalian species. Therefore PFOS fulfil the criteria for being considered as persistent organic pollutants.

Perfluorooctanoic acid (PFOA) and its salts are suspected to have a similar risk profile to PFOS, and consequently the Commission shall keep under review the ongoing risk assessment activities which should be applied within the European Union. There is no European legal limit for PFOA specified yet. PFOA has been

4.15.3 Regulations / Specific test method

EU REACH Regulation (EC) n°1907/2006 Candidate List of Substances of Very High Concern (SVHC).

There is no standardized method of analysis for textiles but the general principle is to use thermal desorption of the solvent from the textile material or solvent extraction and subsequent analysis using GC-MS, or, in some cases, GC-MS headspace (with appropriate internal standards).

5 Others

5.1 pH

5.1.1 General

pH of textile products is the resultant of chemical treatments or finishing (including domestic washing), for which the pH solution (basic or acid) is set up in order to optimize the efficiency of the chemical reaction, and then, the solution is neutralized such as the textile products can be available for human skin contact.

If some finishing step fails, the pH neutralization cannot be reached. pH is only measurable from aqueous extraction.

5.1.2 Why is it critical?

Human skin can bear a wide range of pH from acid to basic, although a very acid pH or basic pH can, in some pH sensitive cases, lead to skin irritation.

5.1.3 Regulation/Specific tests method

Based on several regulation (national or regional), the textile parts of the product should have a pH within the range of 4,0 to 7,5 (associated to a direct contact to skin) or 4,0 to 9,0 (associated to without contact to skin). The upper limit could be extended to 10,5 if the textile semi-product will be treated by further wet process).

Sources (non exhaustive list): regulation from China (GB 18401).

Test method: ISO 3071, GB/T 7573 (China, based on ISO 3071).

5.2 Colour fastness in relation to acidic and alkaline perspiration (recommendation for screening)

The colour fastness to acidic and alkaline perspiration of textile parts should

be at least 3-4, both in terms of colour change and of staining.

Test method: EN ISO 105-E04.

5.3 Polycyclic aromatic hydrocarbons (PAH) (screening when strong odour)

5.3.1 General

PAHs (polycyclic aromatic hydrocarbons) are a group of hundreds of chemicals that can be formed during the incomplete combustion of coal, oil, petrol and other organic substances.

They may occur as impurity in leather, rubber, coated or plastic items that contain petrol and hydraulic oils.

NOTE: It is very hard to assess how common the presence of PAH are in various mineral oils and consequently in leather or rubber items.

5.3.2 Why is it critical?

For 15 PAHs, tests on animals have shown carcinogenic properties, the most toxic is Benzo[a]pyrene (BaP).

5.3.3 Regulations / Specific test method

PAHs are regulated in EU REACH Regulation (EC) n°1907/2006, Annex XVII.

Articles shall not be placed on the market for supply to the general public, if any of their rubber or plastic components that come into direct as well as prolonged or short-term repetitive contact with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of use, contain more than 1 mg/kg (0,0001 % by weight of this component) of any of the listed PAHs (benzo(a)pyrene, benzo(e)pyrene, benzo(a)anthracene, chrysen, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene and dibenzo(a, h)anthracene).

Toys, including activity toys, and childcare articles, shall not be placed on the market, if any of their rubber or plastic components that come into direct as well as prolonged or short-term repetitive contact with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of use, contain more than 0,5 mg/kg (0,00005 % by weight of this component) of any of the listed PAHs.