

**Table I: Hazardous substances in EEE – high priority (Draft Version Passive Components -> 26.03.2008)**

ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder Input		
					Specification of use: component(s) in which substance is contained	Quantity	General comments
1	Antimony trioxide	1309-64-4	Carc Cat. 3 R40	Synergist brominated flame retardants;	used in varistor ceramics as synergist in flame retardants		In ceramic material it is only a structural fragment of a major chemical composition, thus with different properties compared as to substance itself  necessary to fulfil request on flame protected components (e.g. UL94 V0). There are no substitutes that are as effective.
2	Antimony compounds	-	Xn; R20/22 N; R51-53	Flame retardant; melting agent in CRT glass; solder material (antimony-tin)  Melting agent in CRT glass	a) Solder for high reliability applications  b) High Performance Ceramic Materials for Passive Components such as Varistors (e.g. The presence of antimony in a certain application of multilayer varistors in the form of the very stable and inert spinel Zn7Sb2O12, which combines the advantageous electrical conductivity with high mechanical stability and homogeneous phase formation. These	a) Content of antimony in solder 1% ... 2%  Content of antimony in typ. application 0,015% ... 0,05% (based on printed circuit board with electronic components)  b) Content between 2%/per component, weight of the component between 6mg and 60 mg	No alternative lead free solder without antimony for high reliability applications available  No alternative for the mentioned ceramic application (-> b)  Environmental impact is evaluated as low because of low content of antimony.  Exemptions will be definitely necessary

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					functions are necessary for the high current stability and longevity of our multilayer varistors. The combination of the inertness of this spinel, together with its very low content within the ZnO matrix, induces no ecological reason to avoid any of the basic materials used c)		
3	Arsenic/arsenic compounds	7440-38-2	T; R23/25 N; R50-53	III-V group semiconductor substrate (GaAs) Flame retardant	photodiodes and thermal imaging GaAs layers in Coloured LED's, Active components and switches As can be alloying element in brass (about 0,15%)  e.g. CuZn36Pb2As, Material number CW602D Group D according EN12164 / DIN17672		if banned, exemptions necessary there is no alternative available up to now
4	Beryllium metal	7440-41-7	Carc. Cat. 2; R49 T+; R26	In alloys; copper-beryllium alloy; Connectors: contact springs,	Used in ceramic components in electronics and other	typical content in specific surge arrester	Copper-beryllium is the spring material that has the longest life and is

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			T; R25-48/23 Xi; R36/37/38 R43	improves elasticity of copper alloy; Finger clips PCs: maintains electrical conductivity in metal housing; Monitors Relays: improves properties of copper contact springs Switches: high strength, high conductivity Laser printers: Rotating mirror, lightweight rigidity for precision instrumentation	passive components e.g. specific surge arrester 3 %in copper alloys. Precision co-axial connectors to meet high reliability (xks connects) standard IEEE Std 287-2007 to 110 Ghz.	0,14%/component (mean mass 2g per component, very roughly estimated 5 Mio pcs/a as worst case in Europe) = about 15 kg/a	the most reliable. It is also more expensive than steel or phosphor bronze (inferior substitutes) and so is used generally only if there is no alternative, such as failsafe for surge arresters  Due to its CuBe does not generate electric sparks and is suitable for explosive protection equipment (see e.g.) <a href="http://www.ngkdbg.de/prодукte/qualitae.htm">http://www.ngkdbg.de/prодукte/qualitae.htm</a>  Exemptions will definitely be necessary
5	Beryllium oxide BeO	1304-56-9	Carc. Cat. 2; R49 T+; R26 T; R25-48/23 Xi; R36/37/38 R43	In ceramics, as cooling device; Thermally conductive electrical insulator			In ceramic material BeO is only a structure fragment of a major chemical composition, thus with different properties compared BeO as a substance itself
6	Tetrabromo bisphenol A and related compounds (see Table II)	79-94-7	Dangerous to the environment  N; R50/53	Flame retardant	TBBPA is one of the monomers to form the epoxy resin, therefore <b>it is no longer exists as a free chemical in the final product</b> but forms part of the polymeric backbone of the resin. As a <b>reactive chemical</b>	Content 5 % - 8% in printed circuit boards with even less with electronic components	TBBPA is not classified as persistent, bioaccumulative and toxic (PBT), but is classified as R50/53 (very toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment). Risks linked to its use have been

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					TBBPA is used in more than 95% of FR-4 and CM-3 printed circuit boards, the most commonly used boards.		carefully evaluated under the EU risk assessment (RA) process, according to Reg. 793/93/CE, where it was concluded that TBBPA presents no risk to human health, no risk to the environment for reactive use.  <b>RA 2006:</b> <a href="http://ecb.jrc.it/documents/Existing-Chemicals/RISK_ASSESSMENT/REPORT/tbbpaHHreport402.pdf">http://ecb.jrc.it/documents/Existing-Chemicals/RISK_ASSESSMENT/REPORT/tbbpaHHreport402.pdf</a>  <b>RA 2007:</b> ongoing <a href="http://ecb.jrc.it/documents/Existing-Chemicals/RISK_ASSESSMENT/DRAFT/R402_0706_env_hh.pdf">http://ecb.jrc.it/documents/Existing-Chemicals/RISK_ASSESSMENT/DRAFT/R402_0706_env_hh.pdf</a>
7	Bisphenol A (4,4'-Isopropylidendiphenol)	80-05-7	Repr. Cat. 3; R62 Xi; R37-41 R43	Polycarbonate plastic in electronic devices, medical equipment; in PVC as hardener, catalyst, binding agents, stabiliser; epoxy resin production	- > see comments made by chemical and plastics industry		
8	Diethylhexylphthalate (DEHP)	117-81-7	Repr. Cat. 2; R60-61	Plasticizer in PVC cables	- > see comments made by chemical and plastics industry		
9	Butylbenzylphthalate (BBP)	85-68-7	Repr. Cat.2; R61 Repr. Cat.3; R62 N; R50-53	Plasticizer in PVC cables	- > see comments made by chemical and plastics industry		

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10	Dibutylphthalate (DBP)	84-74-2	Repr. Cat. 2; R61 Repr. Cat. 3; R62 N; R50	Plasticizer in PVC cables	- > see comments made by chemical and plastics industry		
11	Diethylphthalate (DOP)	117-84-0	Dangerous to the Environment	Plasticizer in PVC cables	- > see comments made by chemical and plastics industry		
12	Dimethylformamide (DMF)	68-12-2	Repr. Cat. 2; R61 Xn; R20/21 Xi; R36	Electrolyte capacitors	- > see comments made by chemical and plastics industry		
13	Formaldehyde	50-00-0	Carc. Cat. 3; R40 T; R23/24/25 C; R34 R43	Preservatives, monomer (e.g. phenol resin and melamine resin)	- > see comments made by chemical and plastics industry		
14	Gallium arsenide	1303-00-0	Human carcinogen*	Power amplifiers, semiconductors	> see As		
15	Hexabromocyclododecane (HBCDD) and further brominated flame retardants (see table II)	3194-55-6	not (yet) classified in the Annex I of Directive 67/548/EEC; proposal: R33, R64, N R50-53; PBT	Flame retardant	- > see comments made by chemical and plastics industry		
16	Liquid crystals e.g. MBBA (4-methoxybenzylidene-4-butylaniline); 5CB (4-pentyl-4-cyanobiphenyl)			Electroactive layer in liquid crystal displays of cellular phones, notebooks, PC monitors	-		
17	Medium-chained chlorinated paraffins	85535-85-9		secondary plasticisers in PVC (cable) flame retardant	- > see comments made by chemical		

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	(MCCP) (Alkanes, C14-17, chloro)			plasticisers in rubbers	and plastics industry		
18	Nickel <sup>1</sup>	7440-02-0	Carc. Cat. 3; R40 R43	Stainless steel, plating; Decorative metal finishes, barrier layers	used in nearly each passive component as diffusion barrier, layer separating Cu/Sn layers of components terminals and as base metal of wires		No skin contact possible. Technically essential to avoid Whisker with lead free terminations such as pure tin.  If banned definitely exemptions being necessary
19	Nonylphenol Nonylphenolpolyglycol ethers (Nonylphenoethoxylates)	25154-52-3 9016-45-9	Repr.Cat.3; R62 Repr.Cat.3; R63 Xn; R22 C; R34 N; R50-53	Surfactants, antioxidant in plastics	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry
20	Perfluorooctane sulfonates <sup>2</sup>	1763-23-1	-	?????	!!!!		already regulated with 76/769/EC!

<sup>1</sup> Only in those applications where nickel is likely to result in direct and prolonged skin exposure

<sup>2</sup> iRestriction does not apply to the following applications or processes: 1) photoresists or antireflective coatings for photolithography processes; 2) photographic coatings applied to films, papers, or printing plates; 3) mist suppressants for nondecorative hard chromium (VI) plating; 4) wetting agents for use in controlled electroplating systems

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21	PVC	9002-86-2	Dependent on the additives (stabilizers and plasticizer) used;  Dioxin formation during incineration;  Source of organic bound chlorine	Sleeve material (of capacitors), cables, tubing films labels and gaskets, insulator, chemical resistance, transparency, sheath material	used with large passive components such as power inductors (cables) but also a sealing for Aluminium Electrolyte capacitors  - > see comments made by chemical and plastics industry	as sealing only a few mg per component.	- > see comments made by chemical and plastics industry
22	PCBs Polychlorinated Biphenyls	1336-36-3 and various others	R33 N; R50-53  Dioxin/furan formation during incineration	Flame retardant in PVC plastic cable; capacitors	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry
23	PCT Polychlorinated Terphenyls	61788-33-8 and various others		Electrical insulation medium, Plasticizers, fire retardants, coatings for electrical wire and cable, dielectric sealants	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry
24	Polychlorinated Naphthalenes	70776-03-3		lubricant, paint, stabilizer (electric characteristic, flame-resistant, water-resistant) insulator, flame retardant	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry
25	Selenium	7782-49-2	T; R23/25 R33 R53  Toxic/ Danger of cumulative effects / Environment**	Rectifiers and detector instruments, photoreceptor, semiconductor material, light receiving element, photocell	not for passive components		

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26	Short-chained chlorinated paraffins (SCCP) (Alkanes, C10-13, chloro)	85535-84-8	Carc. Cat. 3; R40 N; R50-53	plasticisers in PVC (cable) flame retardant plasticisers	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry
27	Synthetic vitreous fibres -glass fibres - mineral wool - refractory ceramic fibre (RCFs)	142844-00-6	RCF: Carc. Cat. 2;	Thermal insulation materials in domestic electrical appliances	- > see comments made by chemical and plastics industry no use with passive components		- > see comments made by chemical and plastics industry
28	Tributyl Tin (TBT) compounds  Triphenyl Tin (TPT) compounds	various	T; R25-48/23/25 Xn; R21 Xi; R36/38 N; R50-53;  T; R23/24/25 N; R50-53	Stabilizer, antioxidant, antibacterial and antifungal agents, antifoulant, antiseptic, anti-fungal agent, paint, pigment, antistaining	!!!		Already restricted by 76/769/EEC and REACH (item 20 of Annex XVII)  Additional restrictions on TBT and TPT under 76/769/EEC (point 20 of Annex I to Directive 76/769/EEC) close to final adoption
29	Tributyl Tin Oxide (TBTO)	56-35-9	No classification according to 67/548	antiseptic, antifungal agent, paint, pigment, antistaining, refrigerant, foaming agent, extinguishant,	!!!!		Already restricted by 76/769/EEC and REACH (item 20 of Annex XVII)
30	dinickel trioxide	1314-06-3	Carc. Cat. 1; R49 R43 R53	May be used as an electrolyte	in principle part of ceramics (varistors, NTC) but see comment	typically 20 % in NTC, 1% in varistors	usually incorporated into a ceramic crystal lattice  In ceramic material it is only a structural fragment of a major chemical composition, thus with different properties compared as to substance itself



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31	diarsenic trioxide; arsenic trioxide	1327-53-3	Carc. Cat. 1; R45 T+; R28 C; 34 N; R50-53	May be used in certain glass-materials, less than 5000ppm	no use with passive components		
32	4,4'-methylenedi-o-toluidine	838-88-0	Carc. Cat. 2; R45 Xn; R22 R43 N; R50-53	Potential use as a dye	- > see comments made by chemical and plastics industry		
33	Petrolatum; Petrolatum	8009-03-8	Carc. Cat. 2; R45	Used in solder fluxes/pastes	not contained in passive components		
34	nickel dihydroxide	12054-48-7	Carc. Cat. 3; R40 Xn; R20/22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	not contained in passive components  reasonable not contained in ceramic materials or metal		not contained in ceramic materials as sinter temperatures for ceramic materials are between 1000°C and 1500°C and Nickel dihydroxide decomposes > 230°C (see GESTIS database)
35	tributyl phosphate	126-73-8	Carc.Cat.3; R40 Xn; R22 Xi; R38	May be present in certain plastics, metallic- or ceramic materials	- > see comments made by chemical and plastics industry  reasonable not contained in ceramic materials or metals		not contained in ceramic materials as sinter temperatures for ceramic materials are between 1000°C and 1500°C and tributyl phosphate decomposes at 400°C (see GESTIS Database)
36	divanadium pentaoxide; vanadium pentoxide	1314-62-1	Muta. Cat. 3; R68 Repr. Cat. 3; R63 T; R48/23 Xn; R20/22 Xi; R37 N; R51-53	May be present in certain plastics, metallic- or ceramic materials	contained in specific ceramic materials		usually incorporated into a ceramic crystal lattice  In ceramic material it is only a structural fragment of a major chemical composition, thus with different

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							properties compared as to substance itself
37	nickel sulphate	7786-81-4	Carc. Cat. 3; R40 Xn; R22 R42/43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	not contained in passive components or reasonable in metals or ceramic materials		not contained in ceramic materials as sinter temperatures for ceramic materials are between 1000°C and 1500°C and Nickel Sulfate decomposes at 840°C (see GESTIS database) application see GESTIS, used as e.g. fungicide
38	cobalt oxide	1307-96-6	Xn; R22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	used with certain ceramic materials for passive components  e.g. part of ceramics (varistors, NTC)		usually incorporated into a ceramic crystal lattice  In ceramic material it is only a structural fragment of a major chemical composition, thus with different properties compared as to substance itself
39	cobalt	7440-48-4	R42/43 R53	May be present in certain plastics, metallic- or ceramic materials	may be present in alloys etc.		
40	2-ethylhexyl acrylate	103-11-7	Xi; R37/38 R43	2-Ethylhexyl acrylate is used as a monomer in the chemical industry for the production of polymers and copolymers, which are mainly processed further to aqueous polymer dispersions. The polymers and polymer dispersions are used in adhesives and as binders for paints. Other applications	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry

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				include coatings raw materials and uses in the plastics and textiles industries.			
41	Naphthenic acids, copper salts; copper naphthenate	1338-02-9	R10 Xn; R22 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	not contained in passive components or reasonable in metals or ceramic materials		not contained in ceramic materials as sinter temperatures for ceramic materials are between 1000°C and 1500°C and copper naphthenate boils between 150°C and 250°C (see GESTIS database) main application see GESTIS, used as e.g. fungicide
42	phenyl bis(2,4,6-trimethylbenzoyl)-phosphine oxide	162881-26-7	R43 R53	May be present in certain plastics, metallic- or ceramic materials	not contained in passive components or reasonable in metals or ceramic materials		not contained in ceramic materials as sinter temperatures for ceramic materials are between 1000°C and 1500°C and copper naphthenate boils between 150°C and 250°C (see GESTIS database)
43	thallium	7440-28-0	T+; R26/28 R33 R53	May be present in certain plastics, metallic- or ceramic materials	-		
44	bromobenzylbromotoluene, mixture of isomers	99688-47-8	Xn; R48/22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry

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45	2,2'-(ethylenedioxy)diethyl diacrylate; triethylene glycol diacrylate	1680-21-3	Xi; R36/38 R43	May be used in carton materials	- > see comments made by chemical and plastics industry		- > see comments made by chemical and plastics industry
46	Rosin; colophony [1]	8050-09-7 [1] 8052-10-6 [2] 73138-82-6 [3]	R43	Used in solder fluxes/pastes	not contained in passive components		

**Table II: Brominated flame retardants (other than PBBs or PBDEs) (JIG, 2007)**

<b>Brominated Flame Retardants (other than PBBs or PBDEs)</b>	<b>CAS Numbers</b>
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(14) [Aliphatic/alicyclic brominated compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(15) [Aliphatic/alicyclic brominated compounds in combination with antimony compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(16) [Aromatic brominated compounds excluding brominated diphenyl ether and biphenyls]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(17) [Aromatic brominated compounds excluding brominated diphenyl ether and biphenyls] in combination with antimony compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(22) [Aliphatic/alicyclic chlorinated and brominated compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(42) [Brominated organic phosphorus compounds]	-
Poly(2,6-dibromo-phenylene oxide)	69882-11-7
Tetra-decabromo-diphenoxy-benzene	58965-66-5
1,2-Bis(2,4,6-tribromo-phenoxy) ethane	37853-59-1
3,5,3',5'-Tetrabromo-bisphenol A (TBBA)	79-94-7
TBBA, unspecified	30496-13-0
TBBA-epichlorhydrin oligomer	40039-93-8
TBBA-TBBA-diglycidyl-ether oligomer	70682-74-5
TBBA carbonate oligomer	28906-13-0
TBBA carbonate oligomer, phenoxy end capped	94334-64-2
TBBA carbonate oligomer, 2,4,6-tribromo-phenol terminated	71342-77-3
TBBA-bisphenol A-phosgene polymer	32844-27-2
Brominated epoxy resin end-capped with tribromophenol	139638-58-7
Brominated epoxy resin end-capped with tribromophenol	135229-48-0
TBBA-(2,3-dibromo-propyl-ether)	21850-44-2
TBBA bis-(2-hydroxy-ethyl-ether)	4162-45-2
TBBA-bis-(allyl-ether)	25327-89-3
TBBA-dimethyl-ether	37853-61-5
Tetrabromo-bisphenol S	39635-79-5
TBBS-bis-(2,3-dibromo-propyl-ether)	42757-55-1
2,4-Dibromo-phenol	615-58-7
2,4,6-tribromo-phenol	118-79-6
Pentabromo-phenol	608-71-9
2,4,6-Tribromo-phenyl-allyl-ether	3278-89-5
Tribromo-phenyl-allyl-ether, unspecified	26762-91-4
Bis(methyl)tetrabromo-phtalate	55481-60-2
Bis(2-ethylhexyl)tetrabromo-phtalate	26040-51-7
2-Hydroxy-propyl-2-(2-hydroxy-ethoxy)-ethyl-TBP	20566-35-2
TBPA, glycol-and propylene-oxide esters	75790-69-1
N,N'-Ethylene -bis-(tetrabromo-phthalimide)	32588-76-4
Ethylene-bis(5,6-dibromo-norbornane-2,3-dicarboximide)	52907-07-0
2,3-Dibromo-2-butene-1,4-diol	3234-02-4
Dibromo-neopentyl-glycol	3296-90-0
Dibromo-propanol	96-13-9
Tribromo-neopentyl-alcohol	36483-57-5
Poly tribromo-styrene	57137-10-7
Tribromo-styrene	61368-34-1

**Table III: Hazardous substances in EEE already regulated by existing legislation**

Substance name	CAS-Nr.	Main use in EEE	Hazard	Key Legal and Regulatory Information
Asbestos	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5	Brake lining pad, insulator, filler, abrasive, insulator, filler, pigment, paint, talc, adiabatic material	Carc. Cat. 1; R45 T; R48/23	76/769/EEC, Marketing and Use of Dangerous Substances and amendments: (83/478/EEC; 85/610/EEC; 87/217/EEC; 91/659/EEC; 99/77/EEC)
Specific Azocolourants and azodyes (which form certain aromatic amines)	Various	Pigment, dyes, colorants		76/769/EEC, Marketing and Use of Dangerous Substances and amendments: (2002/61/EC; 2003/03/EEC).
Ozone Depleting Substances and Hydrochlorofluorocarbons	Various	Refrigerant, foaming agent, insulation extinguishant		Regulation (EC) No. 2037/2000 on substances that deplete the ozone layer