

**ERA Technology Ltd submission to possible additional RoHS substances study, March 2008.**

**Table I: Hazardous substances in EEE – high priority**

ERA input in purple

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;	Equipment housings, mouldings, connectors and many other electrical components		On-going EU risk assessment incomplete. To comply with obligatory fire regulations, Sb <sub>2</sub> O <sub>3</sub> must be used with most types of brominated flame retardants and in PVC. There are no substitutes that are as effective. Only brominated flame retardants are suitable for some types of plastic <sup>1</sup> . IARC classifies antimony oxide as a “possible carcinogen” which is the same classification as coffee.
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	Also used as a yellow pigment for ceramics and plastics		Need to consult with pigment manufacturers. Need to determine if there is a risk from these pigments or any potential substitutes.
3	Arsenic/arsenic compounds	7440-38-2	T; R23/25 N; R50-53	III-V group semiconductor substrate (GaAs) Flame retardant	Semiconductor devices and lasers. Also in photodiodes and thermal imaging – Category 9 applications)		Arsenic based semiconductors are used because of their unique combinations of characteristics. There are no alternatives for most applications.
4	Beryllium metal	7440-41-7	Carc. Cat. 2; R49 T+; R26 T; R25-48/23 Xi; R36/37/38 R43	In alloys; copper-beryllium alloy; Connectors: contact springs, improves elasticity of copper alloy;			CuBe is the spring material that has the longest life and is 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

<sup>1</sup> Danish EPA study – see table 2.2 <http://www2.mst.dk/Udgiv/publications/2007/978-87-7052-351-6/pdf/978-87-7052-352-3.pdf>

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				<p>Finger clips</p> <p>PCs: maintains electrical conductivity in metal housing;</p> <p>Monitors</p> <p>Relays: improves properties of copper contact springs</p> <p>Switches: high strength, high conductivity</p> <p>Laser printers: Rotating mirror, lightweight rigidity for precision instrumentation</p>			generally only if there is no alternative.
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			BeO has the highest thermal conductivity of any electrically insulating material. Its thermal conductivity is similar to that of copper and so is used as an insulator on high power semiconductors to conduct heat away from the device. The next best material is aluminium nitride which has a thermal conductivity only one half that of BeO. BeO is expensive and so is used only if there are no alternatives. Parts containing BeO should be marked with a warning that it is present.
6	Tetrabromo bisphenol A and related compounds (see Table II)	79-94-7	Dangerous to the environment  N; R50/53	Flame retardant	<p>Reactive FR in PCB laminates so only traces present.</p> <p>Additive FR in ABS. Some possible alternatives are more hazardous, others are inadequately tested</p>		<p>EU risk assessment carried out. Final recommendations not yet determined.</p> <p>Risk minimal and should be dealt with by REACH.</p>

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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	Used to make epoxy resin but very little should be present in equipment.		EU risk assessment carried out. Recommendations should be covered by REACH since it is used in many other non electrical applications.
8	Diethylhexylphthalate (DEHP)	117-81-7	Repr. Cat. 2; R60-61	Plasticizer in PVC cables			There are non-phthalate plasticisers available. All are not fully tested so risks are not known.
9	Butylbenzylphthalate (BBP)	85-68-7	Repr. Cat.2; R61 Repr. Cat.3; R62 N; R50-53	Plasticizer in PVC cables			There are non-phthalate plasticisers available. All are not fully tested so risks are not known.
10	Dibutylphthalate (DBP)	84-74-2	Repr. Cat. 2; R61 Repr. Cat. 3; R62 N; R50	Plasticizer in PVC cables			There are non-phthalate plasticisers available. All are not fully tested so risks are not known.
11	Diocetylphthalate (DOP)	117-84-0	Dangerous to the Environment	Plasticizer in PVC cables			There are non-phthalate plasticisers available. All are not fully tested so risks are not known.
12	Dimethylformamide (DMF)	68-12-2	Repr. Cat. 2; R61 Xn; R20/21 Xi; R36	Electrolyte capacitors			Uncommon or rare solvent for electrolytic capacitors. Most electrolytic capacitors use glycols.
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)			Used to make polymers and so not present in electrical equipment. Recent research has cast doubt on whether this is a carcinogen.
14	Gallium arsenide	1303-00-0	Human carcinogen*	Power amplifiers, semiconductors	See item 3		GaAs semiconductor uses less power, is less susceptible to heat and is much faster than silicon. It is therefore used for very high frequency ICs and other devices. GaAs is however difficult to make and so much more expensive than silicon.

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							As a result it is always used <u>only</u> if there is no alternative
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			On-going EU risk assessment. Mainly used in fabrics so uncommon in electrical equipment so better to control risk via REACH which would include all products put on EU market.
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	Definition of how widely these substances are used in electrical goods is required.		Most liquid crystal materials used in electrical equipment are believed to be non-hazardous.
17	Medium-chained chlorinated paraffins (MCCP) (Alkanes, C14-17, chloro)	85535-85-9		secondary plasticisers in PVC (cable) flame retardant plasticisers in rubbers			EU risk assessment completed and recommendations should be followed.
18	Nickel <sup>2</sup>	7440-02-0	Carc. Cat. 3; R40 R43	Stainless steel, plating; Decorative metal finishes, barrier layers			Most uses cannot be replaced by alternatives. The only risk identified for nickel metal is already controlled by item 27 of Annex XVII of REACH.
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			Not used in electrical equipment as already restricted in EU by 76/769/EEC (item 46 of Annex XVII of REACH).

<sup>2</sup> Only in those applications where nickel is likely to result in direct and prolonged skin exposure

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20	Perfluorooctane sulfonates <sup>3</sup>	1763-23-1	-				Will be banned by 76/769/EEC and REACH except where no alternatives are available so no need for RoHS to duplicate.
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			PVC itself is not hazardous. The combination of properties are very difficult to duplicate with alternative plastics for some applications.
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			Use restricted by 76/769/EEC but surprisingly this has not been included in Annex XVII of REACH.  Not used in electrical equipment
23	PCT Polychlorinated Terphenyls	61788-33-8 and various others		Electrical insulation medium, Plasticizers, fire retardants, coatings for electrical wire and cable, dielectric sealants			Already restricted by 76/769/EEC and will also be restricted by REACH (item 1 of Annex XVII).
24	Polychlorinated Naphthalenes	70776-03-3		lubricant, paint, stabilizer (electric characteristic, flame-resistant, water-resistant)			

<sup>3</sup> Restriction 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 non-decorative hard chromium (VI) plating; 4) wetting agents for use in controlled electroplating systems

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					Specification of use: component(s) in which substance is contained	Quantity	General comments
				insulator, flame retardant			
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	Uses include alloy additive, in glass, light detection semiconductors such as infrared detectors (category 9).  Rarely used in rectifiers. Selenium rectifiers used principally as spare parts, not used in new equipment.		Selenium is an essential mineral in the human diet and so trace quantities in the environment are normal and beneficial. Has many uses where replacement is difficult or impossible.
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			EU risk assessment completed and recommendations should be followed
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			Used as thermal insulation & needed for ovens, heaters, etc. Must be efficient to prevent heat losses and to ensure maximum energy efficiency. Some materials are superior to others but risks also vary.
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/EC and REACH (item 20 of Annex XVII).
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/EC and REACH (item 20 of Annex XVII).

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30	dinickel trioxide	1314-06-3	Carc. Cat. 1; R49 R43 R53	May be used as an electrolyte	Use as battery electrolyte is outside scope of RoHS.  Also used to make pigments which are mixed oxides and usually do not contain dinickel trioxide		Already restricted by item 27 of Annex XVII of REACH.
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	This is no longer used in glass.		
32	4,4'-methylenedi-o-toluidine	838-88-0	Carc. Cat. 2; R45 Xn; R22 R43 N; R50-53	Potential use as a dye	This compound is not a dye but may be used to make azo dyes.		Used to make dyes but this compound should not be present in products except as impurity. Consider adding to list of azo dyes that are restricted by 76/769/EEC and REACH.
33	Petrolatum; Petrolatum	8009-03-8	Carc. Cat. 2; R45	Used in solder fluxes/pastes			ERA is unaware of any uses in electrical equipment.
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			Used to make nickel pigments but not present in product. Nickel compounds are already restricted by item 27 of Annex XVII of REACH.
35	tributyl phosphate	126-73-8	Carc. Cat. 3; R40 Xn; R22 Xi; R38	May be present in certain plastics, metallic- or ceramic materials			May be used in inks and adhesives but uncommon or very rare in electrical equipment.
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	V2O5 is not used in plastics, metals or ceramics but it is used to make other materials that are used as additives to these materials.		Only use of V <sub>2</sub> O <sub>5</sub> in electrical equipment is as a heat detector such as in microbolometers (category 9).

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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	Used to make other nickel compounds, not used in electrical equipment		Nickel compounds already restricted by item 27 of Annex XVII of REACH.
38	cobalt oxide	1307-96-6	Xn; R22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	Used to make pigments		
39	cobalt	7440-48-4	R42/43 R53	May be present in certain plastics, metallic- or ceramic materials			Metal used in special alloys and in electroplated coatings such as NiFeCo which is a substitute for chromium plating that avoids the need to use carcinogenic hexavalent chromium.
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 include coatings raw materials and uses in the plastics and textiles industries.			Not aware of any uses in electrical equipment. Used as chemical intermediate so better to control by REACH.
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			Used as a wood preservative.
42	phenyl bis(2,4,6-trimethylbenzoyl)-phosphine oxide	162881-26-7	R43 R53	May be present in certain plastics, metallic- or ceramic materials			
43	thallium	7440-28-0	T+; R26/28 R33	May be present in certain plastics, metallic- or ceramic	Has been used in photocells and infrared		Used in X-ray detectors (Categories 8 & 9). The possible substitutes contain

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			R53	materials	detectors but these have largely phased out.		mercury, cadmium or lead but are not drop-in replacements.
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			
45	2,2'-(ethylenedioxy)diethyl diacrylate; triethylene glycol diacrylate	1680-21-3	Xi; R36/38 R43	May be used in carton materials			
46	Rosin; colophony [1]	8050-09-7 [1] 8052-10-6 [2] 73138-82-6 [3]	R43	Used in solder fluxes/pastes			Only risk is as a skin sensitiser which is already controlled by EU legislation <sup>4</sup> .

### Comments on table II.

The hazardous properties and risks of most brominated and non-brominated flame retardants are not fully known. Restricting one type of flame retardant forces manufacturers to use others which, if not fully tested, could pose a greater risk to health or the environment<sup>5</sup>. It would therefore be preferable to wait until REACH has progressed to a stage where full data on all potential alternatives is available so that manufacturers can choose the safest materials that meet their fire retardant and other requirements.

<sup>4</sup> HSE guide, page 5 <http://www.hse.gov.uk/pubns/indg249.pdf>

<sup>5</sup> See also ECB report (page 17, 3rd of paragraph section 5) [http://ecb.jrc.it/documents/Existing-Chemicals/Review\\_on\\_production\\_process\\_of\\_decaBDE.pdf](http://ecb.jrc.it/documents/Existing-Chemicals/Review_on_production_process_of_decaBDE.pdf)

**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