

Table I: Hazardous substances in EEE – high priority

ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
1	Antimony trioxide	1309-64-4	Carc Cat. 3 R40	Synergist brominated flame retardants;	<p>Synergist for brominated flame retardants in plastics, for example in housings, wire and cable, connectors and other electrical components (1-7%w).</p> <p>Used as a melting agent in certain special glass, enamel and ceramic manufacture (up to 1.5% w). Glass-Ceramic hobs in Household appliances (Sb<sub>2</sub>O<sub>3</sub>-free alternatives only partly exist). Also used in lamps.</p>	<p>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 to meet the UL94-V0 specifications. There are no substitutes that are as effective. Only brominated flame retardants are suitable for some types of plastic<sup>1</sup>.</p> <p>In most final products, antimony trioxide is encapsulated in a matrix, in which it is physically bound, such as in flame retarded rubbers, plastics and textile back coatings, chemically bound in a transformed state, such as in PET and pigments, or incorporated by a mineralogical melting process, such as in glass. Only by way of wear processes (dry abrasion) is any release as diantimony trioxide feasible. However, such release of antimony trioxide has been investigated and been found to be extremely low, to levels far below any concern.</p> <p>Metals and metal oxides contained in glasses are firmly incorporated in the glass matrix and do not exhibit a toxic potential under normal conditions of use. There is no alternative in special applications.</p> <p>ATO has been going through a Risk Assessment under the Existing Substance Regulation 793/93, and will be finalized before summer. No risks have been identified for consumer exposure including E&amp;E applications. ATO is neither a PBT, a vPvB nor a CMR 1 or CMR 2 substance. Nor is it an endocrine disruptor.</p>

<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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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	<p>See ID No. 1.</p> <p>Halophosphate fluorescent powders in certain fluorescent lamps (1% w).</p> <p>Lamp glass - antimony for glass fining. Antimony compounds (typically Sb 0.0 – 0.4% of the batch) used as a refining agent for some glasses in the domestic glass sector and as oxidising agent for photovoltaic glass.</p> <p>Antimony in some lead-free solder types, for high-reliability applications (1-2% w, usually &lt;0.05% w).</p> <p>High Performance Ceramic Materials for Passive Components such as Varistors.</p> <p>Also used as a yellow pigment for ceramics and plastics.</p> <p>Flame retardant for plastics and melting agent for glasses.</p>	<p>There is no release of the substance from the applications.</p> <p>No alternative lead free solder without antimony for high reliability applications available.</p> <p>Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use. Most of these glass products are compatible with food contact regulations.</p> <p>During recycling conditions, the glass-matrices can be considered very stable against any environment and accelerated leaching tests indicate high chemical inertness. At the end of life of these glass products the antimony leaching is below the EN12457 standard (inert waste).</p> <p>No alternative for the ceramic application. Antimony is present in a very stable and inert form (spinel Zn7Sb2O12), which combines advantageous electrical conductivity with high mechanical stability and homogeneous phase formation, giving high current stability and longevity.</p> <p>Most antimony compounds used in E&amp;E are not classified as dangerous according to Annex I of Directive 67/548/EEC (Sb, Sb2O5, Sb2S3, Sb2S5). Merely sodium Antimonate is classified as dangerous (N and R51/53 above 25% concentration limits) but this high concentration is not used in E&amp;E applications. Neither is there scientific data available indicating that antimony compounds meet the criteria for substances of very high concern. There is consequently no scientific reason to justify their presence on this list of high priority hazardous substances.</p>

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3	Arsenic/arsenic compounds	7440-38-2	T; R23/25 N; R50-53	III-V group semiconductor substrate (GaAs) Flame retardant	<p>See ID No. 31.</p> <p>Glass-Ceramic hobs in Household appliances (As-free alternatives only partly exist).</p> <p>Semiconductor devices and lasers. Also in photodiodes and thermal imaging – Category 9 applications.</p> <p>Semiconductor substrate (e.g. GaAs, GaInAs, GaInAsP, AlGaAs), doping in semiconductors.</p> <p>Fining agent in certain special glasses, &lt;1% w..</p> <p>Arsenic / arsenic compounds are not used as flame retardants.</p>	<p>Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use.</p> <p>During recycling conditions, the glass-matrices can be considered very stable against any environment and accelerated leaching tests indicate high chemical inertness.</p> <p>Arsenic based semiconductors are used because of their unique combinations of characteristics. There are no alternatives for most applications.</p> <p>If restricted, exemptions would be needed as there is currently no available alternative.</p> <p>Proprietary critical use in energy saving applications in electronic equipment.</p>
4	Beryllium metal	7440-41-7	Carc. Cat. 2; R49 T+; R26 T; R25-48/23 Xi; R36/37/38 R43	<p>In alloys; copper-beryllium alloy;</p> <p>Connectors: contact springs, improves elasticity of copper alloy;</p> <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>Used in ceramic components in electronics.</p> <p>Used at maximum 2% w in copper alloys.</p> <p>Precision co-axial connectors to meet high reliability (xks connects) standard IEEE Std 287-2007 to 110 GHz..</p> <p>Because beryllium metal is transparent to x-rays, it is widely used as the window on high-resolution x-ray machines used for</p>	<p>Be is used in very small amounts (ppm range) in EEE.</p> <p>Copper-beryllium 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 alternative.</p> <p>Products manufactured with copper beryllium are more efficient, conserve energy and natural resources, and increase product life.</p>

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				Laser printers: Rotating mirror, lightweight rigidity for precision instrumentation	mammography. A useful property of copper beryllium is its corrosion resistance. Copper-beryllium housings are specifically used in under-water applications to protect the electronics from the corrosive effects of seawater.	
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	Substance may be present in electronic components of energy saving lamps and control gear.	Properties of Beryllium metal and beryllium oxide are required for high standard precision connectors. Beryllium Oxide 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.  These substances are very valuable and thorough recycling is economically interesting.
6	Tetrabromo bisphenol A and related compounds (see Table II)	79-94-7	Dangerous to the environment	Flame retardant	Monomer in epoxy resins (5-8% w).	TBBPA is reactively bound in the resin matrix. The monomer is only present in final product as residue in traces (amount <0.5%)

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			N; R50/53		Use as flame retardant in ABS plastics not relevant for Household appliances..	<p>Risk assessment has been carried out : No risk was identified for human health in any of the applications<sup>2</sup>. No risk to the environment when TBBPA is used as a reactive component in the production of printed circuits boards. For one use of TBBPA as an additive flame retardant in EEE plastics casings, a low environmental risk was identified in one production plant in Europe. No risk was identified for the other production plants or in end use articles like EEE products.</p> <p>RoHS Directive was considered as possible measure to reduce risks, but not withheld by EU Authorities. The IPPC directive was agreed as the most appropriate regulatory tool to address the risk identified.</p> <p>The final conclusion at the risk reduction strategy meeting<sup>3</sup> was "The meeting agreed with the proposed recommendation that local emissions to the environment to be controlled by national rules. Conclusion: The recommendation was endorsed by the meeting. COM will finalise and progress to publish once RA is finalised."</p>
7	Bisphenol A (4,4'-Isopropylidenediphenol)	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	BPA is a chemical intermediate produced and used globally to make polymers such as polycarbonate plastics and epoxy resins. The	<p>The hazard category is incorrect; it should be "Repr. Cat. 3, R62; Xn; R37; R41; R43"</p> <p>Neither polycarbonate nor epoxy resins can be made without BPA. There are no alternative materials available that offer the same combination and balance of desired and required properties of polycarbonate or</p>

<sup>2</sup> 2,2',6,6'-tetrabromo-4,4'-isopropylidenediphenol (tetrabromobisphenol-A or TBBP-A) Risk Assessment Part II – Human Health Final Report, 2006  
[http://ecb.jrc.it/documents/Existing-Chemicals/RISK\\_ASSESSMENT/REPORT/tbbpaHHreport402.pdf](http://ecb.jrc.it/documents/Existing-Chemicals/RISK_ASSESSMENT/REPORT/tbbpaHHreport402.pdf)

<sup>3</sup> European Commission, DG Environment, 15th Risk Reduction Strategy Meeting (Council Regulation (EEC) 793/93), Doc: ES/08/2007, Brussels, 24 January 2008

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					<p>final polymers contain only technically unavoidable trace levels of BPA.</p> <p>Examples for uses in E&amp;E sector:</p> <ul style="list-style-type: none"> <li>- PC is used because of its unique technical properties as such or in various blends in e.g.</li> <li>- housings for cell phones, TVs, computers, copiers, coffee makers, hairdryers, etc.</li> <li>- front panels for electric cookers</li> <li>- electrical kettles</li> <li>- backlight units for TVs</li> <li>- housings for switch modules, distributor boxes, fuses, sockets, etc.</li> <li>- plugs and plug connectors</li> <li>- switches</li> <li>- lamp holders</li> </ul> <p>Epoxy resins are used e.g. for</p> <ul style="list-style-type: none"> <li>- Pottings/encapsulation electronic parts (transformers, inductors)</li> <li>- Printed circuit boards</li> </ul>	<p>epoxy resins in one product.</p> <p>Governments and scientific bodies worldwide have conducted numerous risk assessments for BPA, confirming that BPA-based products can safely be used:</p> <ul style="list-style-type: none"> <li>- The EU commission conducted two risk assessments for BPA under the existing chemicals regulation (initially in 2003, updated in 2007 conclusions at TC NES December 2007); these do not identify any reasons for concern related to consumer use of BPA-based products. This includes IT-applications</li> <li>- BPA is positively listed for use to manufacture polymers with food contact , the European Food Safety Authority EFSA reconfirmed this in its 2007 reassessment of BPA and even increased the TDI (Tolerable Daily Intake) by a factor of 5 due to the strength of the available scientific data.</li> <li>- These conclusions are confirmed by governmental bodies world wide like the US FDA (2005/2007) and the Japanese METI (2005)</li> </ul> <p>BPA is not eligible as a SVHC according to the latest scientific information because BPA is</p> <ul style="list-style-type: none"> <li>- Not carcinogenic, mutagenic or toxic for reproduction category 1 or 2</li> <li>- Not persistent, bioaccumulative or toxic</li> <li>- Not very persistent or very bioaccumulative</li> <li>- Not an endocrine disrupter according to the Weybridge definition</li> </ul> <p>Use aspect: BPA has a very low vapour pressure resulting in a very low likelihood for evaporation during use of BPA based E/E devices.</p>

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					Very minor use of BPA is as a component in antioxidant formulations for soft PVC which may be used e.g. in cables. The use of BPA as catalyst is not a known application.	End of life aspects: BPA-based products such as polycarbonate or epoxy resins can safely be reused, recycled or energetically recovered.  An EU risk assessment has been 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	Very little DEHP is used in EEE applications. Can be present in cables and wiring of energy saving lamps and control gears.	Risk assessment clearly demonstrates that DEHP does not pose a risk in EEE applications <sup>4</sup> . Alternatives for plasticizers in cables are available but all are not fully tested so the risks are not known. These types of cables could be used in energy saving lamps and control gears for safety reasons.
9	Butylbenzylphthalate (BBP)	85-68-7	Repr. Cat.2; R61 Repr. Cat.3; R62 N; R50-53	Plasticizer in PVC cables	Almost no BBP is used in EEE applications. Can be present in cables and wiring of energy saving lamps and control gears.	Risk assessment clearly demonstrates that BBP does not pose a risk in EEE applications <sup>5</sup> . Alternatives for plasticizers in cables are available but all are not fully tested so the risks are not known. These types of cables could be used in energy saving lamps and control gears for safety reasons.
10	Dibutylphthalate (DBP)	84-74-2	Repr. Cat. 2; R61 Repr. Cat. 3; R62 N; R50	Plasticizer in PVC cables	Almost no DBP is used in EEE applications. Can be present in cables and wiring of energy saving lamps and control gears.	Risk assessment clearly demonstrates that BBP does not pose a risk in EEE applications <sup>6</sup> . Alternatives for plasticizers in cables are available but all are not fully tested so the risks are not known. These types of cables could be used in energy saving lamps and control gears for safety reasons.

<sup>4</sup> EU Official Journal, 7 February 2008 (Commission Communication C/2008 34/1 and Commission Recommendation L 33/8); <http://www.dehp-facts.com/RA>

<sup>5</sup> [http://ecb.jrc.it/home.php?CONTENU=/DOCUMENTS/Existing-Chemicals/RISK\\_ASSESSMENT/REPORT/](http://ecb.jrc.it/home.php?CONTENU=/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/)

<sup>6</sup> [http://ecb.jrc.it/home.php?CONTENU=/DOCUMENTS/Existing-Chemicals/RISK\\_ASSESSMENT/REPORT/](http://ecb.jrc.it/home.php?CONTENU=/DOCUMENTS/Existing-Chemicals/RISK_ASSESSMENT/REPORT/)

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11	Diocetylphthalate (DOP)	117-84-0	Dangerous to the Environment	Plasticizer in PVC cables	<p>Almost no DNOP is used in EEE applications that we are aware of because very little is produced and it is never used by itself anyway.</p> <p>Can be present in cables and wiring of energy saving lamps and control gears.</p>	<p>DOP should actually be DNOP for DI-N-Octylphthalate (CAS number is correct - name is wrong).</p> <p>Alternatives for plasticizers in cables are available but all are not fully tested so the risks are not known.</p> <p>These types of cables could be used in energy saving lamps and control gears for safety reasons</p>
12	Dimethylformamide (DMF)	68-12-2	Repr. Cat. 2; R61 Xn; R20/21 Xi; R36	Electrolyte capacitors	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)	<p>Used globally to make polymers, for example phenolic and melamine resins.</p> <p>Used in printed circuit boards and in lamp cement (bonding glass and base).</p> <p>Also used/found in Ply Wood in Household Appliances, release at high temperature is possible.</p>	<p>The final polymers contain only trace levels of formaldehyde.</p> <p>German Indoor-Air-limits restricting emissions already exist.</p> <p>Use of "E1" (<math>\leq 0.1</math> ppm in equilibrium) material would not endanger consumers.</p>



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14	Gallium arsenide	1303-00-0	Human carcinogen*	Power amplifiers, semiconductors	<p>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.</p> <p>State of the art substrate of many LED types; no alternatives available for many colours.</p>	<p>GaAs is a core semiconductor technology with a dominant position in Power Amplifiers and certain chipsets for the handset market worldwide.</p> <p>GaAs semiconductor uses less power, is less susceptible to heat and is much faster than silicon. GaAs is a dopant in semiconductor material; substrate in many LED applications.</p> <p>LED is going to be a very energy efficient light source for general lighting and other purposes.</p> <p>There are no alternatives to GaAs as growth substrate for high performance AlGaInP and AlGaAs LED.</p> <p>Substitution where possible already done with silicon-doped materials. No further substitution possible.</p> <p>GaAs is not classified as a carcinogen.</p>
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	<p>HBCDD has very minor use in V2 housings made from high impact polystyrene.</p> <p>Not all of the further brominated flame retardants listed in Table II are not used in E&amp;E equipment (some are wood preservatives and some are used in foams).</p>	<p>HBCDD is largely used in the construction industry for polystyrene foam flame retardancy. It is undergoing the EU risk reduction process – we need to wait for the outcome before making any decision on inclusion in the RoHS directive. R64 and R33 were not proposed for classification – this needs to be corrected in the Öko-Institut proposal.</p> <p>HBCDD use is uncommon in electrical equipment, so better to control risk via REACH which would include all products put on EU market.</p> <p>Listing further brominated flame retardants (BFRs) in Table II simply on the grounds that their use in E&amp;E equipment or in other consumer products is “intensively discussed” is discriminatory and not based on science.</p> <p>The BFR list in Table II is based on the JIG list, which was put together for declaration purposes only and was not meant for regulatory purposes. Further, no suggestion is made that these substances meet the criteria set out by the Commission for a priority</p>

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						substance. We therefore request that Table II be removed completely from the priority list.
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	Liquid crystal displays.	New developments in Liquid Crystals have not been taken into account.
17	Medium-chained chlorinated paraffins (MCCP) (Alkanes, C14-17, chloro)	85535-85-9		secondary plasticisers in PVC (cable) flame retardant plasticisers in rubbers	Can be present in cables and wiring of energy saving lamps and control gears.	EU risk assessment completed and recommendations in the draft Risk Reduction Strategy should be followed. MCCP allowed for continued use in PVC and rubber. Risk Reduction Strategies will be finalised soon (April 2008); suggestion to wait for conclusions of 15 <sup>th</sup> Risk Reduction Strategies Meeting.
18	Nickel <sup>7</sup>	7440-02-0	Carc. Cat. 3; R40 R43	Stainless steel, plating; Decorative metal finishes, barrier layers	Used in pigments. Widely used in lamps both for holder and current carrying parts having no direct skin contact and also for plating parts like Edison bases. Used for plating in automotive and optical special applications further in glass to metal encapsulations. In medicinal products and electronic glass/Metal	Nickel and nickel containing alloys are used for holder and current carrying parts to prevent inserting oxygen impurity inside lamps. Nickel plating is used to make parts corrosion resistant at elevated temperature. No alternatives available. EU Risk Assessment confirmed a no risk conclusion for consumers. The only risk identified for nickel metal (prolonged skin contact) is already controlled by item 27 of Annex XVII of REACH. Applicable EU standard: Nickel finishes that release greater than 0.5 µg/cm <sup>2</sup> /week must not be used on the external surface of any product designed to be frequently handled or carried by the user (or intended

<sup>7</sup> Only in those applications where nickel is likely to result in direct and prolonged skin exposure

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					encapsulations as CrNi-Steel and NiCo-Steel. All without permanent skin contact.	to be in direct and prolonged skin contact). Measurement to be performed using EN 1811:1998. Prolonged skin contact partially relevant for consumer electronics.
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	Nonylphenol is not a surfactant. It is an intermediate and is not used as such as an antioxidant in plastics. It is not used in EEE applications.  Nonylphenol ethoxylates are surfactants and can be used in coatings for films in EEE, and in formulations to clean printed circuit boards. However, with the introduction of 76/769/EEC those cleaning uses have been phased out since January 2005.	Both substances are already restricted in EU by 76/769/EEC (item 46 of Annex XVII of REACH) for those applications having substantial risk.  The C&L shown is valid for nonylphenol only.  Nonylphenol ethoxylates are classified and labeled as N, R51/53 and R22, R41 (depending on degree of ethoxylation)
20	Perfluorooctane sulfonates <sup>8</sup>	1763-23-1	-		Photoresists or antireflective coatings.	Already regulated by 76/769/EEC, in force on 27th June 2008.
21	PVC	9002-86-2	Dependent on the additives (stabilizers and plasticizer)	Sleeve material (of capacitors), cables, tubing films labels and gaskets, insulator, chemical	Present in cables and wiring of energy saving lamps and control gears. Used as sheath material	PVC is a material and should be taken out of a substance list.  PVC itself is not hazardous

<sup>8</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 nondecorative hard chromium (VI) plating; 4) wetting agents for use in controlled electroplating systems

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			used;  Dioxin formation during incineration;  Source of organic bound chlorine	resistance, transparency, sheath material	for transparent fibre-optical cables.	<p>The combination of properties are very difficult to duplicate with alternative plastics for some applications. For example, there are no substitutes as sheath material for transparent fibre-optical cables offering the required balance of transparency, flexibility and electrical safety.</p> <p>Commission Decision 2001/118/EC “amending Decision 2000/532/EC as regards the list of wastes” does not mention PVC. This Decision mentions plastics waste under several entries which could be relevant for E&amp;E waste, namely:</p> <ul style="list-style-type: none"> <li>• 160119 (plastic waste not otherwise specified),</li> <li>• 191204 (plastics and rubber waste from mechanical treatment of waste),</li> <li>• 200139 (plastics from municipal wastes including separately collected fractions)</li> </ul> <p>All these entries qualify such plastic waste as non-hazardous.</p> <p>The “<i>Basel Convention on the Control of the Transboundary Movements of Hazardous Wastes and Their Disposal</i>” does not consider PVC waste as hazardous.</p> <p>The European Union Commission’s Green Paper on the “Environmental Issues of PVC” published in July 2000 states further that “at the current levels of chlorine in municipal waste, there does not seem to be a direct quantitative relationship between chlorine content and dioxin formation”.</p>
22	PCBs Polychlorinated Biphenyls	1336-36-3 and various others	R33 N; R50-53	Flame retardant in PVC plastic cable; capacitors	PCBs use in PVC was discontinued at least 30 years ago.	Use already restricted by 76/769/EEC.

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			Dioxin/furan formation during incineration			
23	PCT Polychlorinated Terphenyls	61788-33-8 and various others		Electrical insulation medium, Plasticizers, fire retardants, coatings for electrical wire and cable, dielectric sealants	Not used anymore in EEE.	Use already restricted by 76/769/EEC and by REACH (item 1 of Annex XVII)
24	Polychlorinated Naphthalenes	70776-03-3		lubricant, paint, stabilizer (electric characteristic, flame-resistant, water-resistant) insulator, flame retardant	Was a HPV before the 1980's, then production in US and EU stopped. No known current production or uses in EU and US.	Currently the major sources of PCN's in the environment is incineration, formation similar to e.g. dioxins. Candidate POP under UNECE LRTAP <sup>9</sup> .
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. Potential large scale application in low-cost solar cells. Is used as colouring agent in certain special glasses, less than 1%.	Selenium is an essential mineral in the human diet and so trace quantities in the environment are normal and beneficial. It is not classifiable for human carcinogenicity. Has many uses where replacement is difficult or impossible; no less hazardous alternatives are available. Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use. During recycling conditions, the glass-matrices can be considered very stable against any environment and accelerated leaching tests indicate high chemical inertness. Proprietary critical use in energy saving applications in electronic equipment.

<sup>9</sup> <http://www.unece.org/env/popsxg/2000-2003/pcn.pdf>

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ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
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	<p>Not relevant for polymers - SCCP are no longer used in PVC.</p> <p>Only used during production of EEE – i.e. in metal working (molding, etc), but not in final products.</p>	Already restricted by 76/769/EEC and by REACH (item 42 of Annex XVII) for metal working and fat liquoring of leather.
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	<p>Glass fibres and mineral wool used as thermal insulation material in ovens.</p> <p>Used in speciality adhesives and bonding products for EEE.</p>	<p>Synthetic vitreous fibres are covered by an existing EC marketing of hazardous goods directive.</p> <p>Components containing refractory ceramic fibres as described in Commission Directive 97/69/EC of 5 December 1997, adapting to technical progress Council Directive 67/548/EEC relating to the classification, packaging and labelling of dangerous substances.</p> <p>Hazard is related to size and shape. Mineral fibers of length &lt; 5 micro meter and diameter of fiber &lt; 3 micro meter when (length of fiber)/(diameter of fiber) &gt; 3. Since the basis of hazard is particle size, this will be difficult to implement in RoHS, where concentration limits are normally used.</p> <p>In some cases the fibre length is sufficient to avoid hazardous characteristics.</p>
28	Tributyl Tin (TBT) compounds  Triphenyl Tin (TPT) compounds	various	<p>T; R25-48/23/25 Xn; R21 Xi; R36/38 N; R50-53;</p> <p>T; R23/24/25 N; R50-53</p>	Stabilizer, antioxidant, antibacterial and antifungal agents, antifoulant, antiseptic, anti-fungal agent, paint, pigment, antistaining	<p>Not known to be used in EEE.</p>	<p>Already restricted by 76/769/EEC and REACH (item 20 of Annex XVII)</p> <p>Additional restrictions on TBT and TPT under 76/769/EEC (point 20 of Annex I to Directive 76/769/EEC) close to final adoption</p>

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ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
29	Tributyl Tin Oxide (TBTO)	56-35-9	No classification according to 67/548	antiseptic, antifungal agent, paint, pigment, antistaining, refrigerant, foaming agent, extinguishant,	Not known to be used in EEE.	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	Not known to be used in EEE. Used as colouring agent in certain special glasses, less than 1%. In certain optical / filter glasses + in radiation shielding applications (e.g. welding). May be contained in concentrations up to 10 %.	Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use. For colouring and optical applications or radiation shielding no alternatives available During recycling conditions, the glass-matrices can be considered very stable against any environment and accelerated leaching tests indicate te high chemical inertness.
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	See ID No.3. Is used as fining agent in certain special glasses and glass ceramics, less than 1% w. Copper foil in printed circuit boards.	See ID No.3. This substance is considered as an arsenic compound. Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use.
32	4,4'-methylenedi-o-toluidine	838-88-0	Carc. Cat. 2; R45 Xn; R22 R43 N; R50-53	Potential use as a dye	Intermediate for colorants production. Type of colorants used in EEE unclear	This compound is not a dye but may be used to make azo dyes. It should not be present in products except as impurity.
33	Petrolatum; Petrolatum	8009-03-8	Carc. Cat. 2; R45	Used in solder fluxes/pastes	Mineral derivate. May be used in solder fluxes and pastes, in ink and lubricants.	Petrolatum (petroleum jelly) has no known uses in EEE. Potential for residues left from human skin contact in production or use. Most petroleum jelly today is consumed as an ingredient in skin lotions and cosmetics. Petroleum

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ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
						jelly is used to moisten plasticine, as part of a mix of hydrocarbons including greater (paraffin wax) and lesser (mineral oil) molecular weights. Petroleum jelly is commonly used as a personal lubricant.
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		Nickel compounds already restricted by 76/769/EEC and under REACH (item 27 of Annex XVII)
35	tributyl phosphate	126-73-8	Carc.Cat.3; R40 Xn; R22 Xi; R38	May be present in certain plastics, metallic- or ceramic materials	<i>No detailed information available.</i>	
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.  Used in special fluorescent lamps with "external ignition strip".  Used as an antistatic material in tapes.  May be used as colouring agent in certain special glasses and glass ceramics, less than <2500 ppm.  Vanadium pentoxide used as as electrolyte in redox batteries.  May be used as a catalyst.	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).  Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use.  During recycling conditions, the glass-matrices can be considered very stable against any environment and accelerated leaching tests indicate te high chemical inertness.  Use of vanadium pentoxide used as one of the electrolytes in redox batteries, but it is only present in the fully charged states and batteries are excluded from the scope of the RoHS Directive.



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ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
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 known to be used in EEE.	Nickel compounds already restricted by 76/769/EEC and under REACH (item 27 of Annex XVII)
38	cobalt oxide	1307-96-6	Xn; R22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials	Ceramic decoration enamel; It may be used as colouring agent in certain special glasses and radiation shielding applications (e.g. welding), less than 5%. Used in lithium ion batteries, magnets, pigments and catalysts.	Due to the mineralogical melting process, metals and metal oxides in special glasses are firmly incorporated in the glass-matrix and do not exhibit a toxic potential under normal conditions of use. For colouring and optical applications or radiation shielding no alternatives available. During recycling conditions, the glass-matrices can be considered very stable against any environment and accelerated leaching tests indicate te high chemical inertness.
39	cobalt	7440-48-4	R42/43 R53	May be present in certain plastics, metallic- or ceramic materials	In NiCo-Steel for glass / metal encapsulations. Used in lithium ion batteries, and in coatings and pigments. Used as a catalyst for film polymerisation in EEE applications. Used in stainless steel as an alloying element.	Ni is part of the alloys produced to give matching expansion to glass. Attempts to replace in catalyst use have been unsuccessful.
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	Not aware of any uses in electrical equipment. May be used in adhesives.	The monomer is used to produce adhesives which may be used in the EEE industry. This monomer is neither classified as carcinogenic nor as PBT. Plastics made from this monomer are allowed to be used in food contact applications.

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ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
				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.		
41	Naphtenic 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	No detailed information available.	Used as a photoinitiator, it is reactively bonded and would only be present as a residual in EEE final products.
43	thallium	7440-28-0	T+; R26/28 R33 R53	May be present in certain plastics, metallic- or ceramic materials	Thallium compounds are used in HID lamps.	No alternative available, as possible substitutes contain mercury, cadmium or lead, but are 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		This substance is banned under EU directive 91/339/EC.
45	2,2'-(ethylenedioxy)diethyl diacrylate; triethylene glycol diacrylate	1680-21-3	Xi; R36/38 R43	May be used in carton materials	Triethylene glycol diacrylate is a monomer, and exists at <1000ppm in the polymer (See ID No. 40).  No use is known in EEE	This monomer is not classified as carcinogenic nor as a PBT.  Used as chemical intermediate and therefore it is better to evaluate it under REACH.
46	Rosin; colophony [1]	8050-09-7 [1] 8052-10-6 [2] 73138-82-6 [3]	R43	Used in solder fluxes/pastes	Not directly relevant for EEE.  Used in lamp cement (bonding glass and base) and solder materials.  Used in manufacture of printed circuit boards.	See ID No. 33 "Petrolatum".  Does it qualify at all as a high priority substance?  During the soldering process rosin reacts with surface oxides which can give rise to fuming.  Any risks associated with the soldering process

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ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder input	
					Specification of use: component(s) in which substance is contained	General comments
					Can be used as a processing aid in the production of polychloroprene elastomers for wire and cable applications.	are managed using appropriate HSE procedures during production. The high temperatures required to cause fuming are not encountered during the life of the final products.  No substitute currently exists for rosin use in polychloroprene elastomer manufacture. A study is available demonstrating no risk sensitising effect.

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**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

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**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