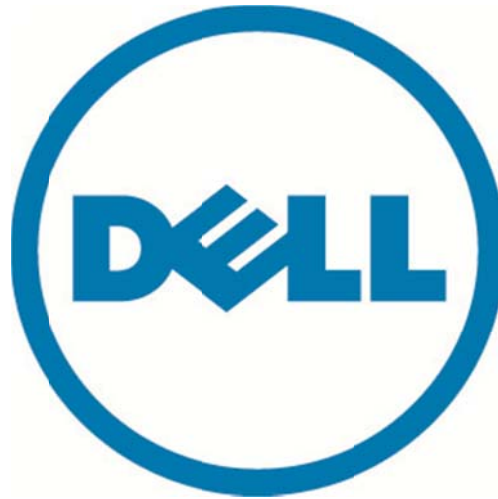


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Materials Restricted for Use

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Scott O'Connell	Scott O'Connell	A13-00	07/15/2011

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1. Revision History

Rev.	ECO #	Revision Description	Approved	Date
A00	126242	Initial Release	David Staggs	4/23/02
A01	132601	Changed author and owner; Updated Definitions; Added thresholds and uses to material descriptions to Section 3; Added Sections 4 & 5	Don Brown	8/9/02
A02	138063	Changed author and owner; Added Appendix A (Cadmium Test Requirement); Updated thresholds in Section 3.	Don Brown	12/9/02
A03	14779	Updated restricted materials table, added "Future Material Restrictions" section	Don Brown	7/2/03
A04	157297	Added References, added legal/market references for each restricted material in Appendix B, updated cadmium, chromium VI and lead restrictions, added azo dye restriction, added South Korea EPS restrictions, added description of General Specification of Allowable Levels of Lead (Pb) in Dell Products specification (Dell P/N D4394), Dell P/N M4461, Dell Lead (Pb) Free Component Requirements	Mark D Newton	2/4/04
A05	169971	Revised thresholds and exempt applications consistent with EU RoHS guidance, added "homogenous material" definition, removed information on analytical testing to a new specification (K8625), revised CAS #s, added Supplier Declaration Process section	Mark D Newton	10/14/04
A06	187072	Eliminated references to Dell General Specification for Allowable Levels of Lead (Pb) in Dell products (Dell P/N D4394), eliminated references to Dell Supplier's Declaration on Restricted or Banned Materials (Dell P/N 7X435), changed "halogenated flame retardants/additives" to "brominated/chlorinated flame retardants", clarified "threshold limit" definition, removed reference to "intentionally added", added definitions for "external cables", "chassis plastic part" and "solder", changed cadmium threshold, added TBTO and PCN restriction, added JIG Level B table, eliminated section on Future Material Content Restrictions, added description of SDoC process	Don K Brown	8/11/05
A07	189195	Removed EA mailbox: WW_Env_Supplier_Program@dell.com .	Scott O'Connell	9/22/05
A08	205983	Revised Introduction section, added definition of "mechanical plastic part", deleted definition of "chassis plastic part", expanded applicability of brominated/chlorinated flame retardant to apply to all mechanical plastic parts, added EU RoHS exemptions	Scott O'Connell	6/30/06
A09	234248	Added references to new EU Battery Directive, Dell Halogen-Free Specification (ENV0199), changed azo dye threshold from 100 ppm to 30 ppm, changed threshold for bromine/chlorine in flame	Scott O'Connell	11/14/07

		retardants from 1000 ppm to 900 ppm, changed cadmium in battery threshold from 250 ppm to 20 ppm per new EU Battery Directive, added additional substances to "JIG Level B & Potential EU REACH substances of very high concern (SVHC)" list		
A10	354740	<p>Section 2.3: Added Dell Specification references ENV0319, 64MNT and a reference to REACH</p> <p>Section 2.4: Added definition of Article and added clarity to mechanical plastic part definition</p> <p>Section 3.: Added reference of test methods below Table 1</p> <p>Table 1: Added PFOS, formaldehyde and PAH substances; modified hexavalent chromium, PVC threshold level and BFR/CFR</p> <p>Section 3.1: modified to include EU RoHS and EU REACH</p> <p>Table 2: Added additional substances from EU RoHS Revision</p> <p>Table 3: Added substances from EU REACH</p> <p>Section 3.2 created: BFR/CFR/PVC-Free requirements</p> <p>Table 4: Modified maximum concentration value of lead from 4000 to 40 ppm</p> <p>Appendix A: Added Formaldehyde, PAH and PFOS</p> <p>Table O added: PFOS examples in Appendix C</p> <p>Table P added: PAH examples in Appendix C</p>	Michael K. Murphy	8/13/2008
A11	575060	<p>Table 1: HBCDD (removed from Table 2 and 3), fluorinated greenhouse gases, perchlorates, Phenol,2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl), radioactive substances; modified threshold levels on BFR/CFR/PVC, PFOS</p> <p>Table 2: Removed organochlorine and organobromine</p> <p>Table 3: Removed Cyclododecane; added Arsenic and coal tars and Tris(2-chloroethyl)phosphate</p> <p>Section 4: Change the reference of South Korea eK Safety Mark to South Korea KC Safety Mark</p> <p>Appendix A: Added phthalates, 4,4'-Diaminodiphenylmethane, chloro (Short Chain Chlorinated Paraffins) (SCCPs), fluorinated greenhouse gases, perchlorates, HBCDD, Phenol,2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl), radioactive substances, tributyl tin oxide</p> <p>Appendix B: Complete update</p> <p>Table 20: cadmium threshold limit changed from 20 to 5 ppm; mercury battery limit changed from 5 to 1 ppm</p> <p>Appendix C: Added Fluorinated Greenhouse Gases, radioactive substances</p>	Michael K. Murphy	5/01/2009
A12	647532	<p>Section 3: Ref to ENV0319 for testing protocols</p> <p>Table 1: Modified the restriction date for HBCDD,</p>	Michael K. Murphy	5/13/2010

		DEHP, BDP, DDP; added language that each of the 3 phthalates must be under 1000 ppm; moved SCCP from table 2 to table 1; added DMF Table 2: Change the word 'component' to 'article' to conform to EU REACH definition. Appendix A: Updated information on SCCP; added DMF Appendix B: Sunset exemptions 11a, 12 and 14; expanded exemption 3		
A13	670888	Section 2.3: Added EPA FIFRA Section 2.4: Added Antimicrobial and non-electrical/non-electronic parts Table 3: Added DBT, DOT and phthalates Section 6 Antimicrobial requirements added Section 7 Non-electrical/electronic requirements added Appendix A updated Appendix B completely revised Table T added	Scott O'Connell	07/15/2011

2. Introduction

Dell's vision is to avoid the use of substances in its products that could seriously harm the environment or human health and to ensure that we act responsibly and with caution. Dell material restrictions are based on consideration for legal requirements, international treaties and conventions, and specific market requirements.

This specification lists substances banned or restricted for use in Dell products and in the manufacture of Dell products. If restricted substances are introduced and/or detected in products, potential courses of action may include developing corrective actions to requalify parts to meet this specification, delaying the launch of products and/or removing non-compliant suppliers from the Dell Approved Vendor List (AVL).

2.1 Purpose

To communicate to Dell design teams and suppliers materials restrictions required for parts in all Dell-branded products. The specification should be used when selecting materials for product parts and packaging.

2.2 Scope

All parts in Dell-branded products that are supplied to Dell and/or designed by Dell Inc. must meet this specification. Compliance with this specification is communicated to Dell via Supplier Declaration of Conformity (SDoC, Dell part number N6685). The scope includes all of the components, parts, assemblies and packaging of each product. The restricted substances cannot be contained in the product or used in the manufacture of the product and its components above the designated thresholds for the controlled applications listed in Section 3.

2.3 References

- Dell P/N ENV0036 , Dell Product Design for Environment Register of Laws and Market Requirements
- Dell P/N N6685, Supplier's Declaration of Conformity (SDoC, declares compliance to 6T198 Specification)
- Dell P/N ENV0199, Dell BFR/CFR/PVC-Free Specification (formerly "halogen-free")
- Dell P/N ENV0319, Dell Material Compliance Testing Specification
- Dell P/N 64MNT, Dell Regulatory Critical Components Peripheral Guide Sheets
- Agile accessible via the ValueChain website (<https://valuechain.dell.com/>) for Suppliers/Vendors.
- Directive of the European Parliament and of the Council on Marketing and Use of Dangerous Substances, 76/769/EEC, July 1976.
- Council Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC, September 2006.
- Directive of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2002/95/EC, January 2003. (RoHS Directive)
- EPA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
- UK Department of Trade and Industry, Sustainable Development and Environment, "RoHS Regulations Government Guidance Notes", August 2005: <http://www.dti.gov.uk/sustainability/weee/>
- Directive of the European Parliament and of the Council on Packaging and Packaging waste, 94/62/EC, December 1994.

- Regulation of the European Parliament and of the Council on the Registration, Evaluation, Authorization and Restriction of Chemicals, 1907/2006/EC, December 2006. (REACH Regulation)
- California Safe Drinking Water and Toxic Enforcement Act of 1986 (Section 25249.5-25249.13 of the California Health and Safety Code), commonly referred to as “California Proposition 65”
- German Ordinance concerning the avoidance and recycling of packaging waste (Packaging Ordinance – VerpackV), August 1998.
- JIG-101: Joint Industry Guide: Material Composition Declaration for Electronic Products, <http://www.jedec.org/download/search/ACF276.pdf>
- Dell P/N ENV0046 , Dell Environmental Affairs Corrective Action Process

2.4 Definitions

- Antimicrobial: An agent that prevents or inhibits microorganisms
- Article: Object which during production is given a special shape, surface or design which determines its function to a greater degree than does its chemical composition (e.g. all Dell parts and products are classified as Articles).
- Assembly: An integrated set of components. A populated printed circuit board is an assembly and not a component because individually functioning components can be removed.
- Brominated/chlorinated flame retardants: flame retardants that contain or are treated with bromine and/or chlorine. These elements are typically added to reduce the flammability of components such as epoxy resins and thermoplastics. Examples include, but are not limited to, tetrabromobisphenol-A (TBBP-A), brominated epoxy oligomer (BEO) and polybrominated diphenyl ethers (PBDEs).
- CAS #: Chemical Abstract System numbers are assigned to chemicals for unique identification. The CAS numbering system is an international convention. For example, the CAS# for lead is 7439-92-1.
- Component: a combination of homogenous materials that have been formed into a single manufactured mechanical or electrical part. Examples of components may include microprocessors, plastic enclosures, coin cell batteries, capacitors, etc. Sub-assemblies and semi-finished goods are not considered components. Examples of sub-assemblies/semi-finished goods may include populated motherboards/daughter cards, power supplies and adaptors, hard drives, tape drives, mouse, etc.
- External cables – cables and cords that are likely to be accessible to the consumer during ordinary use
- Homogenous material: a homogenous material is made up of one or more substances (e.g., an alloy is a homogenous material which in turn is made up of a number of substances). Per the latest EU Commission guidance on RoHS maximum concentration values (July 2004), “homogeneous material means a material that cannot be mechanically disjointed into different materials”. Homogenous materials consist of a uniform composition or phase and include plastics, alloys, finishes, coatings, glass, ceramics, etc.
- Mechanical plastic part – plastic parts that do not internally carry an electrical signal such as housings, brackets, bezels, latches, etc that form the basic structure of the product and/or have mechanical functions. Plastic parts such as fans, connectors, printer fuser assemblies, etc are not considered “mechanical plastic parts” in the context of this specification.
- Non-compliance: A failure to meet the requirements of the specification. Non-compliance requires corrective action.
- Non-electrical/Non-electronic parts and products (Dell Branded): Electricity is not required to operate these parts and products. Examples include, but not limited to, apparel products (e.g. shirts, pants, hats...), stationary products (e.g. pens, pencils, erasers, staplers, key chains, paper pads and notebooks ...), office equipment accessories (e.g. computer bags, locks, mouse pads...) and toys. Packaging materials are excluded from this definition.

- Not detectable: not detectable means that a substance in a part or homogenous material is not detected at the lowest detectable limit using standard analytical techniques.
- Packaging: Materials used to protect products from damage due to storage or transportation (e.g., boxes, shipping supplies, cushioning & foam, bags, shrink wrap, tape/adhesives). Includes inks and dyes used to label packages.
- PPM: parts per million, unit of measurement for weight percentage. 1 ppm = 1 mg/kg = 0.0001 % by weight. For RoHS substances, the parts per million thresholds listed in this specification refer to the weight of the substance in a specific homogenous material, not the weight of the substance in a component or assembly.
- Prolonged skin exposure: with respect to nickel, rate of nickel released from nickel-plated parts coming into direct and prolonged contact with the skin is greater than 0.5 micrograms/cm²/week
- RoHS substances – those substances restricted under the European RoHS Directive (2002/95/EC), including cadmium, chromium VI, lead, mercury, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).
- Solder (in reference to the RoHS exemption for lead in solders for servers, storage and networking products) – alloys used to create metallurgical bonds between two or more metal surfaces to achieve an electrical and/or physical connection”. In this context, the term ‘solder’ also includes all materials that become part of the final solder joint, including solder finishes on components or printed circuit boards.
- Substances: substances are chemical elements and their compounds (e.g. lead is a chemical element and lead oxide is a compound). Registry numbers of the Chemical Abstracts System of the American Chemical Society (CAS #) are attributed to all chemical elements and most of their compounds and should be used for identification purposes.
- Threshold Limit: for RoHS substances (cadmium, chromium VI, lead, mercury, PBBs and PBDEs), the maximum concentration at which a restricted substance can be present in a homogenous material (= mass of restricted substance/mass of homogenous material).

3. Product Content Restrictions

Table 1 lists substances that Dell has banned or restricted. For each listed substance, a threshold limit has been established to account for unavoidable impurities consistent with regulatory requirements. Table 1 also lists allowed exemptions and references to specific restricted substances and CAS numbers (Appendix C). **For RoHS substances, the substance is acceptable only if present in a homogenous material at a quantity at or below the threshold limit for a non-exempt application or if it is used in an exempt application per Appendix B.** Refer to Dell P/N ENV0319 for substance testing protocols and requirements. Compliance with this specification is communicated to Dell via Supplier Declaration of Conformity (SDoC, Dell part number N6685) that will be obtained upon request during part qualification. Appendix A includes a detailed listing of traditional uses of restricted substances.

TABLE 1- Banned or Restricted Substances

Substance	Threshold Limit (mg substance/ kg <u>homogenous material</u> =ppm)	Exemptions	Reference Appendix C
Cadmium and its compounds	100	See Appendix B for RoHS exemptions	Table B
Chromium VI and its compounds	1000 for Non-metallic applications Not Detectable for Metallic Applications	None	Table D
Mercury and its compounds	1000	See Appendix B for RoHS exemptions	Table G
Polybrominated Biphenyls PBBs & their Ethers/Oxides (PBDEs, PBBEs), including deca-BDE	1000	None	Table I
Lead and its compounds in cable jacketing of external cables**	300	None	Table F
Lead and its compounds in other electronic applications**	1000	See Appendix B for RoHS exemptions; Refurbished equipment manufactured prior to July 1, 2006; spare parts for the repair and/or upgrade of equipment previously sold as non-RoHS compliant.	Table F

Refer to Dell Specification ENV0319 for a list of acceptable substance testing standards.

**** Dell “Lead-free” Part Number and Labeling Policy**

1. All lead-free components shall have a lead free manufacturer’s part number that is different than the part number for the leaded version of that part. For suppliers that utilize a model number as their manufacturer’s part number, a suffix may be added in place of a completely new model

number to distinguish the lead free model from the leaded model. Lead-free parts that are currently supplied to Dell do not require new part numbers.

2. The voluntary use of industry standard labels or marks (such as JEDEC JESD97, JEITA ETR-702, or IPC Standard 1066) are **only** allowed on electronic components used to populate circuit board assemblies or on the circuit boards themselves. Marks or labels that indicate or imply “lead-free” are not permitted to be visible to the end user on any Dell part, product or packaging that could be shipped to a customer.

TABLE 1(continued)- Banned or Restricted Substances

Substance	Threshold Limit (mg substance/kg <u>Homogeneous material</u> = ppm)	Exemptions	Reference Appendix C
Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins) (SCCPs)	1000	None	Table S
Asbestos and its compounds	Not Detectable	None	Table A
Azo dyes/colorants	30	Restriction apply to electronic components and products, textiles (including leather) that <u>do not</u> come into direct contact with human skin	Table K
Brominated/Chlorinated flame retardants (excluding PBBs, PBDEs)	1000	Restriction applies to mechanical plastic parts, plastic parts greater than 25 grams and products designated as Halogen Free or BFR/CFR-Free products. Exemption applies to internal plastic components such as circuit boards, electronic components, fans, cables, printer fuser assembly and electrical assemblies contained in Dell products unless designated as Halogen Free or BFR/CFR-Free products	Table L
Dimethyl fumarate (DMF)	0.1	None	CAS #: 624-49-7
Fluorinated greenhouse gases (GHG) (HFC, PFC, SF6)	Not Detectable	Restriction applies to both manufacturing processes and products	Table Q
Formaldehyde (Wood products)	Not Detectable	None	CAS #: 50-00-0
Hexabromocyclododecane (HBCDD) and all major diastereoisomers	1000	Restriction effective by July 1, 2010 for newly launched Dell parts and products and by July 1, 2012 for sustaining products.	CAS #: 25637-99-4; 3194-55-6
Nickel and its compounds	1000	Metallic nickel or nickel alloy exempt in all applications except external chassis/case parts likely to result in prolonged skin exposure. No exemptions for organo-nickel compounds.	Table H
Ozone depleting substances (Class I & Class II CFCs and HCFCs)	Not Detectable	Non-Class I or Class II ozone depleting substances. Restriction applies to both manufacturing processes and products.	Table C, E
Perchlorates	0.006	None	CAS #: 7791-03-9

Perfluorooctane sulfonates (PFOS) and salts, C8F17SO2X (X=OH, metal salt, halide, amide, and other derivatives including polymers).	not detectable	Photoresists or anti-reflective coatings for photolithography processes, photographic coatings applied to films, papers or printing plates.	Table O
Phenol,2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-	Not Detectable	None	CAS #: 3846-71-7
Phthalates: DEHP, BBP and DBP	1000 for each phthalate	Restriction effective by July 1, 2010 for newly launched Dell parts and products and by July 1, 2012 for sustaining products.	(DEHP (CAS#: 117-81-7), BBP (CAS#: 85-68-7), DBP (CAS#: 84-74-2))
Polychlorinated Biphenyls (PCBs) and Terphenyls (PCTs)	Not Detectable	None	Table J
Polychlorinated naphthalene (PCNs)	Not Detectable	None	Table N
Polycyclic Aromatic Hydrocarbons (PAH)	10 (Sum of PAH)	Restriction applies to external plastics and soft surfaces that can experience frequent skin contact. Refer to Dell specification 64MNT for additional details. Concentration limit is the sum of all 16 PAHs.	Table P
Polyvinyl chloride (PVC)	1000	Restriction applies to mechanical plastic parts, plastic parts greater than 25 grams and products designated as Halogen Free or PVC-free products. Cables, connectors, electronic components, battery trays, magnetic tape, and similar non-mechanical plastic parts are exempt unless designated as Halogen Free of PVC-Free products	CAS#: 9002- 86- 2
Radioactive substances	Not Detectable	None	Table R
Tributyl tin (TBT) and Triphenyl tin (TPT) compounds	Not Detectable	None	Table M

3.1 Future Material Declaration Requirements

To encourage industry alignment with the Joint Industry Guide: Material Composition Declaration for Electronic Products (JIG-101), EU RoHS revisions and EU REACH list of Substance of Very High Concern (SVHC), Dell will begin requesting supplier disclosure of the list of substances (Table 2 and 3 below). **It is important to note that these substances are not currently banned or restricted in any application per this specification, however disclosure on their use will enable companies to meet future demands for product content disclosure requirements.** Dell encourages suppliers to begin collecting information on the use/non-use of these substances in their products to facilitate future reporting to Dell.

TABLE 2- Future Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance/ kg <u>article weight</u> =ppm)	Examples of Use	Applicable Requirements
Antimony and its compounds	1000	pigment, paint, catalyst, lead free solder, stabilizer, n-type dopant, flame retardant, catalyst	JIG
Beryllium and its compounds	1000	ceramics, metal alloy, copper-beryllium alloy, catalyst, precipitation hardening alloy, copper-beryllium alloy for spring, solder	JIG
Bismuth and its compounds	1000	lead free solder, solder	Dell Requirement
Bisphenol-A	1000	manufacture of polycarbonate resins (PC)	Dell Requirement
Brominated Flame Retardant (excl. PBB, PBDE, HBCDD and TBBPA)	1000	Flame retardant use on electrical and mechanical components	JIG
Chlorinated Flame Retardant	1000	Flame retardant use on electrical and mechanical components	Dell Requirement
Chloroparaffins, medium-chained (14 – 17 Carbon Chain)	1000	Polyester (softener/fire retardant), insulation and sealants, glue, paint, lacquer, surface treatment (primarily solvent-based), PVC, lubricants/lubrication oils for metalworking, Leather preservation, rubber	Dell Requirement
Phthalates (DINP, DIDP, DNOP, DIBP, DHNUP, DIHP)	1000 for each phthalate	plasticizer, dye, pigment, paint, ink, adhesive, lubricant	JIG
Selenium and its compounds	1000	anti-microbial coating in plastic products and textiles	Dell Requirement
Polyvinyl Chloride (PVC)	1000	Cables, connectors, electronic components, battery trays, magnetic tape, and similar non-mechanical plastic parts	JIG

TetraBromoBisphenol A (TBBPA) Additive and Reactive	1000	Flame retardant used on PCB Laminates and other electrical components	Dell requirement
Triclosan	10	anti-microbial coating in plastic products and textiles	Dell Requirement

TABLE 3- Future Material Declaration Requirements at an ARTICLE LEVEL *
 above 0.1% (W/W) (EU REACH)**

Substance	CAS No.	Contained in EEE products	Used only in manufacturing of EEE products
Anthracene	120-12-7	Radiation equipment	Yes, but rarely used
4,4'-Diaminodiphenylmethane	101-77-9	No	Intermediate for some epoxy resin, specialty polymers and PU foam
Arsenic and its salts (expected)	7440-38-2	pigment, paint, dye, antifoamer for glass, III-V group semiconductor substrate (GaAs), flame retardant	Yes
Coal Tar Distillates, heavy oils (expected)	292-607-4	No	No
Coal Tar Distillates, heavy oils, pyrene fraction (expected)	295-304-5	No	No
Coal Tar Residues, pitch distn (expected)	295-507-9	No	No
Coal Tar Distillates, pitch, pyrene fraction (expected)	295-028-2	No	No
Coal Tar pitch, high temperature (expected)	266-028-2	No	No
Cobalt dichloride	7646-79-9	No	Used in cobalt plating
Dibutyltin (DBT) and Dioctyltin (DOT) compounds	Table T	Stabilizer for PVC, curing catalyst for silicone resin and urethane resin	No
Diarsenic pentaoxide	1303-28-2	No	Hardener for copper, lead and gold alloys
Diarsenic trioxide	1327-53-3	No	Usage in GaAs alloys
All Other Phthalates (exclude DEHP, BBP, DBP, DINP, DIDP, DNOP, DIBP,	All Phthalates	Plasticizer, dye, pigment, paint, ink, adhesive, lubricant	No

DHNUP, DIHP).			
Sodium dichromate	7789-12-0	No	Passivation coating/plating and paint primer
5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)	81-15-2	No	No
Lead hydrogen arsenate	7784-40-9	Wood treatment	No
Bis(tributyltin) oxide (TBTO)	56-35-9	Rarely used. Mainly used for antiseptic, antifungal agent.	No
Tris(2-chloroethyl)phosphate	115-96-8	Flame retardant	No
Triethyl arsenate	15606-95-8	Wood treatment	No

***** The 0.1 % threshold applies to the WHOLE part/product (e.g. components, sub-assemblies, desktop, monitor, server, spare part, but also packaging, manual), NOT to the homogeneous material per EU RoHS.** This is different than the thresholds established under EU RoHS. EU RoHS will remain in force as a separate directive from EU REACH.

3.2 BFR/CFR/PVC-Free “Halogen Free” Requirements

All parts and/or products designed to satisfy “halogen-free” requirements must satisfy Dell’s BFR/CFR/PVC-Free Specification “Halogen-Free Specification”, p/n ENV0199 (in Agile) in addition to this specification. Parts and/or products without a “halogen-free” requirement are not required to comply with ENV0199.

ENV0199 specification is not applicable to Dell Enterprise products.

4. Product Packaging Content Restrictions

Table 4 lists substances that Dell has banned or restricted in product packaging materials supplied to or designed by Dell Inc. These substances cannot be used in the manufacturing of or contained in product packaging materials supplied to or designed by Dell Inc. In some instances, a threshold limit has been established to account for unavoidable impurities. The material is acceptable if the restricted substances are present at a quantity below the threshold limit for a controlled application. For packaging recycle marking requirements (SPI marks and country-specific marks), please see Dell WW Packaging Recycle Marking Specification (G3515, in Agile).

Refer to Appendix C for a detailed list of CAS #'s for each substance below.

TABLE 4

Substance	Threshold Limit (mg/kg=ppm)	Exemptions	Reference Appendix C
Cadmium, Chromium VI, Lead and Mercury compounds	100 (sum of concentrations)	None	Tables B, D, F, G
Ozone depleting substances (Class I & Class II CFCs and HCFCs)	Not detectable	None	Table C, E
Halogenated plastics or polymers (ex: PVC)	Not detectable	None	See Section 2.4 for definition
Expanded polystyrene (EPS) foam*	Not detectable	Product packaging not shipping to S Korea	

South Korea Expanded Polystyrene (EPS) Packaging Restrictions (**applicable to South Korea only**)

Effective January 1, 2004, all finished electronic products that require the South Korean KC safety mark and are under 20,000 cubic centimeters in packaging volume size (about 10.5 inches square), cannot be packaged in EPS material. This EPS restriction will expand to cover larger packaged products as indicated below:

- On January 1, 2008 the packaging volume size increases to cover any product containing packaging under 40,000 cubic centimeters
 1. EPS and any packaging containing EPS (ie. ARCEL) are included in this restriction.
 2. Currently, the South Korean KC mark applies to projectors, speakers, printers, CRT displays, wall mount power adapters and AC adapters. The KC mark does not currently apply to laptops, desktop computers, PDA's, or server products. For more information on the KC mark, please see the Korea Electric Testing Institute website at <http://www.keeti.re.kr/eng/>

5. Battery Content Restrictions

Table 5 lists substances that Dell has restricted in batteries supplied to or designed by Dell Inc. above the indicated threshold limit for unavoidable impurities. Battery technology used in Dell products cannot be based on lead**, mercury or cadmium.

Refer to Appendix C for a detailed list of CAS #'s for each substance below.

TABLE 5

Substance	Threshold Limit (mg/kg=ppm)	Exemptions	Reference Appendix C
Cadmium and its compounds	5	None	Table B
Lead and its compounds	40	Lead-acid batteries (UPS)**, solder used in battery packs	Table F
Mercury and its compounds	1	None except button cells. Button cells must contain <20,000 ppm (<2%) mercury	Table G

** Uninterruptible Power Supply (UPS) units may utilize lead-acid technology. Batteries for this application are subject to certain fees and material labeling requirements.

6. Antimicrobial Additives and Coatings Requirements

If an antimicrobial coating is applied onto a part or product, the antimicrobial coating must satisfy the requirements below:

- The antimicrobial additive or coating must be registered with US EPA FIFRA for use specifically for the application it is intended for (e.g. office equipment, computers...)
- Antimicrobial marketing claims must be consistent with the Treated Article Exemption under FIFRA

Please consult Environmental Affairs if antimicrobial additives or coatings are being considered for use.

7. Non-Electrical/Non-Electronic Parts and Products Requirements

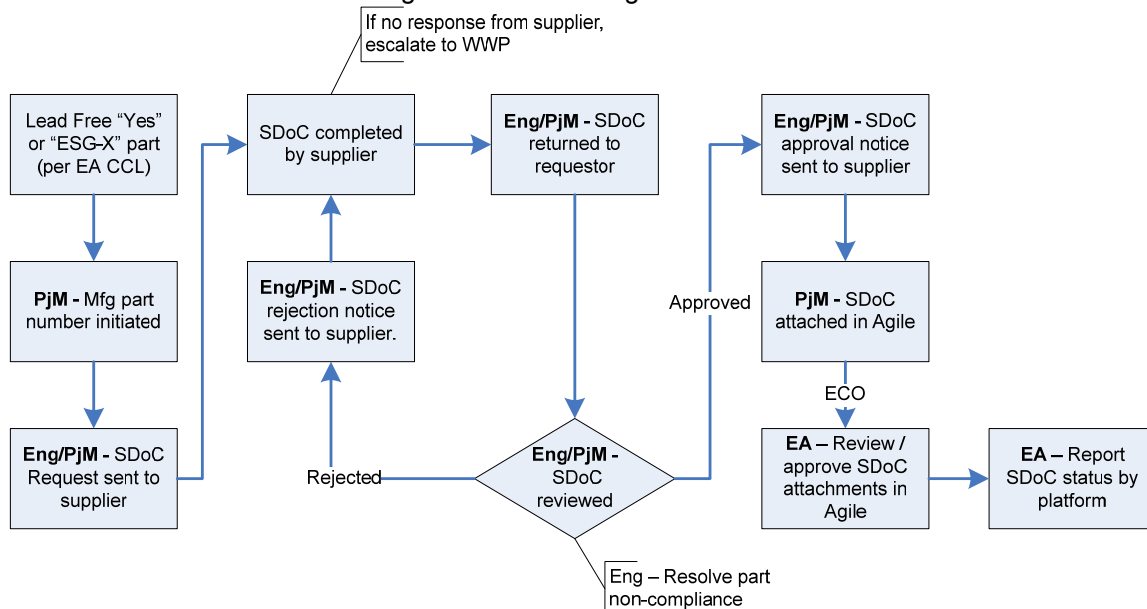
All Dell branded non-electrical and non-electronic parts and/or products must satisfy the minimum requirements below (this list may not be comprehensive and suppliers should comply with local laws and regulations where the products are sold):

Substance	Threshold Limit (mg/kg=ppm)
Lead and its compounds (Pb)	90 PPM
Cadmium and its compounds (Cd)	100 PPM

Mercury and its compounds (Hg)	Not Detectable
Hexavalent Chromium and its compounds (Cr+6)	Not Detectable
Phthalate DEHP, BBP, DBP, DINP, DIDP, DNOP, DIBP and all other phthalates	1000 PPM for each phthalate
Nickel and its compounds	1000 PPM on all surfaces with expected prolonged skin exposure
Additional requirements for textiles, toys and apparels only (e.g. shirts, pants, coats, hats, gloves, shoes...)	Adhere to the latest requirements from the American Apparel & Footwear Association (AAFA) Restricted Substance List (RSL)

8. Supplier Declaration Process

Compliance to this specification is communicated to Dell via Supplier Declaration of Conformity (SDoC, Dell P/N N6685). An SDoC must be completed on each applicable part in Dell's Bill of Materials and attached in Agile to the manufacturer part number attachments tab. Environmental Affairs will review the SDoC during ECO/MCO routing.



Change Notification

If the material, component, assembly or product being supplied to Dell does not meet one or more of the applicable requirements of this specification, the supplier must immediately notify Dell. This notification also applies if the supplier or a subcontractor(s) makes changes in their operations that will cause a material, component, assembly or product to no longer comply with this specification.

9. Non-compliance Resolution

If a restricted substance is used in a nonexempt application above the threshold limit, the following actions may be required to resolve any deviations from this specification:

1. Requalification of parts to comply with specification/ phase out and replacement of use, which may result in removal of non-compliant suppliers from the Dell AVL

2. Delay of product launch
3. Stop ship of product to affected regions

Dell Environmental Affairs Corrective Action Process (ENV0046) should be referenced in non-compliance resolution.

Appendix A: Legal References and Examples of Use

Restricted Substance	Examples of Potential Use	Legal Reference
4,4'-Diaminodiphenylmethane	Foams, polyurethane	Article 59 of REACH Regulation (EC) No 1907/2006
5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)	No likely used in IT products	Article 59 of REACH Regulation (EC) No 1907/2006
Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins) (SCCPs)	Cutting fluids, plasticizer for PVC, flame retardant	Article 33 and 7.2 of REACH Regulation (EC) No 1907/2006 (Candidate list of SVHC for authorization 28.10.2008)
Asbestos and its compounds	Insulator, pigment, paint, fillers (use not expected in electronics)	European Community: Directive 76/769/EEC
Azo dyes/colorants	textile dyes, plastic colorant (earbuds, leather cases)	European Community: 76/769/EEC
Brominated/chlorinated flame retardants / additives	flame-rated plastics (e.g. ABS, HIPS), printed circuit board laminates, component mold compounds	Market Requirement: Blue Angel (German Eco-label); TCO'99/03 (Swedish Eco-label)
Cadmium and its compounds	plastic stabilizers (cables), packaging, dyes/pigments, paints or surface coating/plating treatments	European Community: Directive 91/338 EEC (adds to 76/769/EEC), 2002/95/EC RoHS Directive; China MII Methods
	Toys and textile products	US CPSC; Korea Certification Mark (KC Mark); China FZ/T 81014-2008; Canadian Hazardous Product Act; Cadmium Decree in Netherlands
Chlorofluorocarbons (CFCs)	cleaning agents, foam plastics, solvents	Int'l Treaty: Montreal Protocol, Annex A, B & C; US: 1990 Clean Air Act; European Community: Directive 76/769/EEC
Chloroparaffins, short-chained (10-13 carbon chain)	softener or plasticizer in plastics (cables), paints, coatings, flame retardants in plastics, rubbers	European Community: Directive 76/769/EEC

Chromium VI and its compounds	anti-corrosion surface treatment, stabilizers, colorants, dyes, pigments	European Community: Directive 91/338 EEC (adds to 76/769/EEC), 2002/95/EC RoHS Directive; China MII Methods
	Toys and Textile products	China FZ/T 81014-2008; 18 th regulation on the Amendment of the German Ordinance on Commodities of 3 rd Aug, 2010
Dibutyltin (DBT) and Dioctyltin (DOT) compounds	Stabilizer for PVC, curing catalyst for silicone resin and urethane resin	Article 33 of REACH Regulation (EC) No 1907/2006
Dimethyl Fumarate (DMF)	Biocide, mold treatment on leather	Commission Decision 2009/251/EC
Fluorinated Greenhouse Gases	Refrigerants, blowing agents, extinguishing agents, cleaning agents, insulating media, caustic gas	EU Reg. No. 842/2006
Formaldehyde (in Wood products)	Disinfectant and preservative compound for engineered wood products	California SB 509; CARB restriction on Formaldehyde
Hexabromocyclododecane (HBCDD) and all major diastereoisomers	Flame retardant; mainly used for expanded polystyrene and some types of fiber	Article 33 of REACH Regulation (EC) No 1907/2006
Hydrochlorofluorocarbons (HCFCs)	cleaning agents, foam plastics, solvents	Int'l Treaty: Montreal Protocol, Annex A, B & C; US: 1990 Clean Air Act; European Community: Directive 76/769/EEC
Lead and its compounds	plastic stabilizers (cables)	California Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, Sections 25249.5 – 25249.13 of California Health and Safety Code.
	packaging, dyes/pigments, paints or surface coating/plating treatments	European Community: Directive 89/677/EEC (no limit specified); 2002/95/EC RoHS Directive; China MII Methods
	Toys and textile products	US CPSC; Korea Certification Mark (KC Mark; China FZ/T 81014-2008; Canadian

		Hazardous Product Act
	metal alloys, glass & ceramic curing agent, solders, plating materials	European Community: 2002/95/EC RoHS Directive; China MII Methods
Mercury and its compounds	relays, switches, electrical contacts, lamps and bulbs, resin stabilizer. Use not expected except in lamps and bulbs.	European Community: Directive 91/338 EEC (adds to 76/769/EEC), 2002/95/EC RoHS Directive; Sweden: SFS 1996:319; China MII Methods
	Toys and Textile products	China FZ/T 81014-2008; Canadian Hazardous Product Act
Nickel and its compounds	surface treatment, decorative plating	European Community: Directive 94/27/EEC
Perchlorates	Coin Cell Batteries	US/CA DTSC Rulemaking
Perfluorooctane sulfonates (PFOS) and salts, C8F17SO2X (X=OH, metal salt, halide, amide, and other derivatives including polymers).	Photolithographic, photoacid generators, and anti-reflective coatings (ARCs). Impregnation agents for textiles, paper and leather.	European Community: Directive 2006/122/EC
Phenol,2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-	Adhesives, paints, printing inks, plastics, inked ribbons, putty, caulking or sealing fillers	Japan Law concerning the evaluation of chemical substances
Phthalates: DEHP, BBP and DBP,	Plasticizer, dye, pigment, paint, ink, adhesive, lubricant	Article 33 of REACH Regulation (EC) No 1907/2006; EU Directive 2005/84/EC
Phthalates: DINP, DIDP, DNOP, DIBP, DHNUP, DIHP	Plasticizer, dye, pigment, paint, ink, adhesive, lubricant	Annex XVII of REACH Regulation (EC) No 1907/2006; US CPSIA
Polybrominated Biphenyls (PBBs) and their ethers/oxides (PBDEs)	flame-rated plastics (e.g. ABS, HIPS). PBBs not used in electronics since 1970's.	European Community: Directive 76/769/EEC, penta and octa-BDE restrictions; 2002/95/EC RoHS Directive (exempts deca-BDE); China MII Methods
Polycyclic Aromatic Hydrocarbons (PAH)	Soft and hard plastic surfaces, especially dark plastics	Market Requirement: GS Mark (Germany): ZEK 01-08

Polychlorinated Biphenyls (PCBs) and Terphenyls (PCTs)	transformers, capacitors, printed circuit board components (use not expected in electronics)	European Community: Directive 76/769/EEC; 91/173/EEC; Germany: ChemVerbots V; US: TSCA
Polychlorinated Naphthalene (PCN)	additive to rubber, lubricants and paints (use not expected in electronics)	Japan Law Concerning the Examination and Regulation of the Manufacture of Chemical Substances (Class 1)
Polyvinyl chloride (PVC)	cables, connectors, electronic components, surface protectors (Mylar films), structural plastics	Market Requirement: Blue Angel (German Eco-label); TCO'99/03 (Swedish Eco-label)
Radioactive Substances	optical properties (thorium), measuring devices, gauges, detector	Japan Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material, and Reactors, 1986; US NRC
Tributyl tin (TBT) and, Triphenyl tin (TPT) compounds	inks, paints, pigments, preservatives and fungicides (use not expected in electronics)	Japan Law Concerning the Examination and Regulation of the Manufacture of Chemical Substances (Class 1, Class 2)
Tributyl Tin Oxide (TBTO)	antiseptic, antifungal agent, paint, pigment, antistaining, refrigerant, foaming agent, extinguishant, solvent cleaner	Japan Law concerning the evaluation of chemical substances

Appendix B: EU RoHS Exemptions List

Exemption Number	Exemption	Scope and dates of applicability
1	Mercury in single capped (compact) fluorescent lamp	Restricted on Dell parts
2	Mercury in double-capped linear fluorescent lamps for general lighting purposes	Restricted on Dell parts
3a	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp) short length (< 500mm)	Max 3.5 mg per lamp effective immediately
3b	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp) medium length (>500mm and <1,500mm)	Max 5.0 mg per lamp effective immediately
3c	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp) long length (>1500mm)	Max 13.0 mg per lamp effective immediately
4a	Mercury in other low pressure discharge lamps (per lamp)	Max 15.0 mg per lamp effective

		immediately
4b-I	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index Ra > 60: P < 155W	Max 30.0 mg per lamp effective immediately
4b-II	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index Ra > 60: 155W < P < 405W	Max 40.0 mg per lamp effective immediately
4b-III	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index Ra > 60: P > 405W	Max 40.0 mg per lamp effective immediately
4c-I	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) P < 155W	Max 25.0 mg per lamp effective immediately
4c-II	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) 155W < P < 405W	Max 30.0 mg per lamp effective immediately
4c-III	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) P > 405W	Max 40.0 mg per lamp effective immediately
4d	Mercury in High Pressure Mercury (vapour) lamps (HPMV)	Restriction by Jan 2014
4e	Mercury in metal halide lamps (MH)	No restrictions
4f	Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex	No restrictions
5a	Lead in glass of cathode ray tubes	No restrictions
5b	Lead in glass of fluorescent tubes not exceeding 0,2 % by weight	No restrictions
6a	Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0,35 % lead by weight	No restrictions
6b	Lead as an alloying element in aluminum containing up to 0,4 % lead by weight	No restrictions
6c	Copper alloy containing up to 4 % lead by weight	No restrictions
7a	Lead in high melting temperature type solders (i.e. lead- based alloys containing 85 % by weight or more lead)	No restrictions
7b	Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission, and network management for telecommunications	No restrictions
7c-I	Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectric devices, or in a glass or ceramic matrix compound	No restrictions
7c-II	Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher	No restrictions
7c-III	Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC	Restricted on Dell parts
8a	Cadmium and its compounds in one shot pellet type thermal cut-offs	Restricted on Dell parts
8b	Cadmium and its compounds in electrical contacts	No restrictions
9	Hexavalent chromium as an anticorrosion agent of the carbon steel cooling system in absorption refrigerators up to 0,75 % by weight in the cooling solution	Restricted on Dell parts
9b	Lead in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications	Restricted on Dell parts
11a	Lead used in C-press compliant pin connector systems	Restricted on Dell parts
11b	Lead used in other than C-press compliant pin connector systems	Restricted on Dell parts

12	Lead as a coating material for the thermal conduction module C-ring	Restricted on Dell parts
13a	Lead in white glasses used for optical applications	No restrictions
13b	Cadmium and lead in filter glasses and glasses used for reflectance standards	No restrictions
14	Lead in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80 % and less than 85 % by weight	Restricted on Dell parts
15	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages	No restrictions
16	Lead in linear incandescent lamps with silicate coated tubes	Restricted on Dell parts
17	Lead halide as radiant agent in high intensity discharge (HID) lamps used for professional reprography applications	Restricted on Dell parts
18a	Lead as activator in the fluorescent powder (1 % lead by weight or less) of discharge lamps when used as speciality lamps for diazoprinting reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ((Sr,Ba) ₂ MgSi ₂ O ₇ :Pb)	Restricted on Dell parts
18b	Lead as activator in the fluorescent powder (1 % lead by weight or less) of discharge lamps when used as sun tanning lamps containing phosphors such as BSP (BaSi ₂ O ₅ :Pb)	Restricted on Dell parts
19	Lead with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact energy saving lamps (ESL)	Restricted on Dell parts
20	Lead oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCDs)	Restricted on Dell parts
21	Lead and cadmium in printing inks for the application of enamels on glasses, such as borosilicate and soda lime glasses	Restricted on Dell parts
23	Lead in finishes of fine pitch components other than connectors with a pitch of 0,65 mm and less	Restricted on Dell parts
24	Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors	Restricted on Dell parts
25	Lead oxide in surface conduction electron emitter displays (SED) used in structural elements, notably in the seal frit and frit ring	Restricted on Dell parts
26	Lead oxide in the glass envelope of black light blue lamps	Restricted on Dell parts
27	Lead alloys as solder for transducers used in high-powered (designated to operate for several hours at acoustic power levels of 125 dB SPL and above) loudspeakers	Restricted on Dell parts
29	Lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC (1)	Restricted on Dell parts
30	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more	Restricted on Dell parts
31	Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)	Restricted on Dell parts
32	Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes	Restricted on Dell parts
33	Lead in solders for the soldering of thin copper wires of 100 µm diameter and less in power transformers	Restricted on Dell parts
34	Lead in cermet-based trimmer potentiometer elements	Restricted on Dell parts
36	Mercury used as a cathode sputtering inhibitor in DC plasma displays with a content up to 30 mg per display	Restricted on Dell parts
37	Lead in the plating layer of high voltage diodes on the basis of a zinc borate glass body	Restricted on Dell parts
38	Cadmium and cadmium oxide in thick film pastes used on aluminum bonded	Restricted on Dell

	beryllium oxide	parts
39	Cadmium in colour converting II-VI LEDs (< 10 µg Cd per mm ² of light-emitting area) for use in solid state illumination or display systems	Restricted on Dell parts

Guidance on Lead in solders for servers, storage and networking equipment exemption

(per UK RoHS Regulations Government Guidance Notes, August 2005)

“For the purposes of applications, 8 and 9 in this Annex (below), it is useful to clarify the term ‘solder’. In these Guidance Notes, **‘solder’ is defined as “alloys used to create metallurgical bonds between two or more metal surfaces to achieve an electrical and/or physical connection”.** In this context, the term ‘solder’ also includes all materials that become part of the final solder joint, including solder finishes on components or printed circuit boards.

8. Lead in solders for servers, storage and storage array systems

See definition of ‘solder’ given for application 7 above.

This exemption has been introduced to allow the use of lead in solders for high reliability applications, such as servers, for which viable lead-free alternatives have not yet been identified.

In this context, a **‘server’** is seen as a computer that meets one of the technology criteria that are set out in section (a) below, and the functional criteria set out in section (b) below.

(a) Technology criteria for a server

1) Designed and placed on the market as a Class A product as per EN55022:1994 under the EMC Directive 89/336/EEC (intended primarily for use in the professional environment) and designed and capable of having a single or dual processor capability (one or more sockets on board); or

2) Designed and placed on the market as a Class B product (intended primarily for use in the domestic environment) as per EN55022:1994 under the EMC Directive 89/336/EEC and designed and capable of having at least dual processor capability (two sockets on board).

(b) Functional design criteria for a server

1) Designed and capable of operating in a mission-critical, high-reliability, high availability application in which use may be 24 hours per day and 7 days per week, and unscheduled downtime is extremely low (minutes per year).

Examples of typical server functions are the provision of network infrastructure, gateway or switching services, the hosting and management of data on behalf of multiple users, or the running of server-capable operating systems (e.g. as for a web server).

This exemption is viewed as applying to the whole of the computer and its components including processors, memory boards, power converters, power supplies, enclosed housings, modular power subsystems and adapter cards. It would also seem to apply to the components that are integrated into the whole computer or that are sold separately for use in an exempt server. Cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for the server, would also be covered.

It should be noted that this exemption is not viewed as applying to parts or components that are peripheral to the server, nor does it apply to parts or components when they are used other than in an exempt server.

For the purpose of the RoHS Regulations, a **‘storage or storage array system’** is viewed as any storage device or subsystem that meets one of the following criteria:

1) Designed and placed on the market as a Class A product as per EN55022:1994 under the EMC Directive 89/336/EEC; or

2) Designed and placed on the market as a Class B product as per EN55022:1994 under the EMC Directive 89/336/EEC and designed to meet one of the following two criteria: -

- a) Any storage device capable of accepting direct or switched input from more than one computer, for example fibre channel and SCSI devices, or
- b) Any storage fabric or switching device for interconnecting storage devices to server products.

The exemption is viewed as applying to the whole of the device or subsystem. It should be noted that this exemption does not apply to parts or components that are peripheral to the storage or storage array system, nor does it apply to parts or components when they are used other than in an exempt storage or storage array system.

9. Lead in solders for network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunication,

See definition of 'solder' given for application 7 above.

This exemption has been introduced to allow the use of lead in solders for high reliability applications, such as network infrastructure equipment, for which viable lead-free alternatives have not yet been identified. In this context network infrastructure equipment for telecommunication purposes is viewed as equipment meeting one or more of the following criteria:

- 1) Any system used for routing, switching, signalling, transmission, or network management or network security;
- 2) Any system which can simultaneously enable more than one end user terminating equipment to connect to a network;
- 3) Any system in a network except for end user terminating equipment such as voice terminals and facsimile machines.

This would appear to include all components, power suppliers, display devices and similar electronic units that are incorporated into network infrastructure equipment. It would also include all cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for network infrastructure equipment.

Spare Part and Refurbished Equipment RoHS Exemptions

Spare Parts Exemption - spare parts for the repair of electronic equipment put on the EU market before July 1, 2006 are exempt from RoHS requirements. This is to allow old equipment to be maintained with spare parts and to ensure that old equipment is reused. This exemption is explicitly limited to old equipment, i.e. put on the market before July 1, 2006.

Refurbished Equipment Exemption – equipment originally put on the EU market before July 1, 2006 that is later marketed and sold as “refurbished” (including refurbished whole unit service replacements) is exempt from RoHS requirements.

Appendix C: List of CAS Numbers

Table A - Asbestos and its Compounds

Example compounds and CAS Numbers

Asbestos	1332-21-4
Actinolite	77536-66-4
Amosite (Grunerite)	12172-73-5
Anthophyllite	77536-67-5
Chrysotile	12001-29-5
Crocidolite	12001-28-4
Tremolite	77536-68-6

Table B - Cadmium and its Compounds

Example compounds and CAS Numbers

Cadmium	7440-43-9
Cadmium oxide	1306-19-0
Cadmium sulfide	1306-23-6
Cadmium chloride	10108-64-2
Cadmium sulfate	10124-36-4
Other cadmium compounds	-

Table C – Chlorofluorocarbons (CFC's)

Example compounds and CAS Numbers

Trichlorofluoromethane	75-69-4
Dichlorodifluoromethane (CFC12)	75-71-8
Chlorotrifluoromethane (CFC 13)	75-72-9
Pentachlorofluoroethane (CFC 111)	354-56-3
Tetrachlorodifluoroethane (CFC 112)	76-12-0
Trichlorotrifluoroethane (CFC 113)	354-58-5
1,1,2 Trichloro-1,2,2 trifluoroethane	76-13-1
Dichlorotetrafluoroethane (CFC 114)	76-14-2
Monochloropentafluoroethane (CFC 115)	76-15-3
Heptachlorofluoropropane (CFC 211)	422-78-6 135401-87-5
Hexachlorodifluoropropane (CFC 212)	3182-26-1
Pentachlorotrifluoropropane (CFC 213)	2354-06-5 134237-31-3
Tetrachlorotetrafluoropropane (CFC 214)	29255-31-0
1,1,1,3-Tetrachlorotetrafluoropropane	2268-46-4
Trichloropentafluoropropane (CFC 215)	1599-41-3
1,1,1-Trichloropentafluoropropane	4259-43-2
1,2,3-Trichloropentafluoropropane	76-17-5
Dichlorohexafluoropropane (CFC 216)	661-97-2
Monochloroheptafluoropropane (CFC 217)	422-86-6
Bromochlorodifluoromethane (Halon 1211)	353-59-3
Bromotrifluoromethane (Halon 1301)	75-63-8
Dibromotetrafluoroethane (Halon 2402)	124-73-2
Carbon Tetrachloride (Tetrachloromethane)	56-23-5
1,1,1, - Trichloroethane (methyl chloroform) and its isomers except 1,1,2-trichloroethane	71-55-6
Bromomethane (Methyl Bromide)	74-83-9
Bromodifluoromethane and isomers (HBFC's)	1511-62-2

Table D - Chromium VI and its Compounds

Example compounds and CAS Numbers

Chromium (VI) oxide	1333-82-0
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Barium chromate	10294-40-3
Calcium chromate	13765-19-0
Chromic acetate	1066-30-4
Chromium trioxide	1333-82-0
Lead (II) chromate	7758-97-6
Sodium chromate	7775-11-3
Sodium dichromate	10588-01-9
Strontium chromate	7789-06-2
Potassium dichromate	7778-50-9
Potassium chromate	7789-00-6
Zinc chromate	13530-65-9
Other hexavalent chromium compounds	-

Table E – Hydrochlorofluorocarbons (HCFC’s)

Example compounds and CAS Numbers

Dichlorofluoromethane (HCFC 21)	75-43-4
Chlorodifluoromethane (HCFC 22)	75-45-6
Chlorofluoromethane (HCFC 31)	593-70-4
Tetrachlorofluoroethane (HCFC 121)	134237-32-4
1,1,1,2-tetrachloro-2-fluoroethane (HCFC 121a)	354-11-0
1,1,2,2-tetrachloro-1-fluoroethane	354-14-3
Trichlorodifluoroethane (HCFC 122)	41834-16-6
1,2,2-trichloro-1,1-difluoroethane	354-21-2
Dichlorotrifluoroethane(HCFC 123)	34077-87-7
Dichloro-1,1,2-trifluoroethane	90454-18-5
2,2-dichloro-1,1,1-trifluoroethane	306-83-2
1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a)	354-23-4
1,1-dichloro-1,2,2-trifluoroethane (HCFC-123b)	812-04-4
2,2-dichloro-1,1,2-trifluoroethane (HCFC-123b)	812-04-4
Chlorotetrafluoroethane (HCFC 124)	63938-10-3
2-chloro-1,1,1,2-tetrafluoroethane	2837-89-0
1-chloro-1,1,2,2-tetrafluoroethane (HCFC 124a)	354-25-6
Trichlorofluoroethane (HCFC 131)	27154-33-2;(134237-34-6)
1-Fluoro-1,2,2-trichloroethane	359-28-4
1,1,1-trichloro-2-fluoroethane (HCFC131b)	811-95-0
Dichlorodifluoroethane (HCFC 132)	25915-78-0
1,2-dichloro-1,1-difluoroethane (HCFC 132b)	1649-08-7
1,1-dichloro-1,2-difluoroethane (HFCF 132c)	1842-05-3
1,1-dichloro-2,2-difluoroethane	471-43-2
1,2-dichloro-1,2-difluoroethane	431-06-1
Chlorotrifluoroethane (HCFC 133)	1330-45-6
1-chloro-1,2,2-trifluoroethane	1330-45-6
2-chloro-1,1,1-trifluoroethane (HCFC-133a)	75-88-7
Dichlorofluoroethane(HCFC 141)	1717-00-6; (25167-88-8)
1,1-dichloro-1-fluoroethane (HCFC-141b)	1717-00-6
1,2-dichloro-1-fluoroethane	430-57-9
Chlorodifluoroethane (HCFC 142)	25497-29-4
1-chloro-1,1-difluoroethane (HCFC142b)	75-68-3
1-chloro-1,2-difluoroethane (HCFC142a)	25497-29-4
Hexachlorofluoropropane (HCFC 221)	134237-35-7
Pentachlorodifluoropropane (HCFC 222)	134237-36-8
Tetrachlorotrifluoropropane (HCFC 223)	134237-37-9
Trichlorotetrafluoropropane (HCFC 224)	134237-38-0
Dichloropentafluoropropane, (Ethyne, fluoro-) (HCFC 225)	127564-92-5; (2713-09-9)
2,2-Dichloro-1,1,1,3,3-pentafluoropropane(HCFC 225aa)	
2,3-Dichloro-1,1,1,2,3-pentafluoropropane (HCFC 225ba)	
1,2-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225bb)	128903-21-9
3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC 225ca)	
1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC 225cb)	
1,1-Dichloro-1,2,2,3,3-pentafluoropropane(HCFC 225cc)	422-48-0
1,2-Dichloro-1,1,3,3,3-pentafluoropropane (HCFC 225da)	

1,3-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225ea) 1,1-Dichloro-1,2,3,3,3-pentafluoropropane(HCFC 225eb)	422-44-6 422-56-0 507-55-1 13474-88-9 431-86-7 136013-79-1 111512-56-2
Chlorohexafluoropropane (HCFC 226)	134308-72-8
Pentachlorofluoropropane (HCFC 231)	134190-48-0
Tetrachlorodifluoropropane (HCFC 232)	134237-39-1
Trichlorotrifluoropropane (HCFC 233) 1,1,1-Trichloro-3,3,3-trifluoropropane	134237-40-4 7125-83-9
Dichlorotetrafluoropropane (HCFC 234)	127564-83-4
Chloropentafluoropropane (HCFC 235) 1-Chloro-1,1,3,3,3-pentafluoropropane	134237-41-5 460-92-4
Tetrachlorofluoropropane (HCFC 241)	134190-49-1
Trichlorodifluoropropane (HCFC 242)	134237-42-6
Dichlorotrifluoropropane (HCFC 243) 1,1-dichloro-1,2,2-trifluoropropane 2,3-dichloro-1,1,1-trifluoropropane 3,3-Dichloro-1,1,1-trifluoropropane	134237-43-7 7125-99-7 338-75-0 460-69-5
Chlorotetrafluoropropane (HCFC 244) 3-chloro-1,1,2,2-tetrafluoropropane	134190-50-4 679-85-6
Trichlorofluoropropane (HCFC 251) 1,1,3-trichloro-1-fluoropropane	134190-51-5 818-99-5
Dichlorodifluoropropane (HCFC 252)	134190-52-6
Chlorotrifluoropropane (HCFC 253) 3-chloro-1,1,1-trifluoropropane (HCFC 253fb)	134237-44-8 460-35-5
Dichlorofluoropropane (HCFC 261) 1,1-dichloro-1-fluoropropane	134237-45-9 7799-56-6
Chlorodifluoropropane (HCFC 262) 2-chloro-1,3-difluoropropane	134190-53-7 102738-79-4
Chlorofluoropropane (HCFC 271) 2-chloro-2-fluoropropane	134190-54-8 420-44-0

Table F - Lead and its Compounds

Example compounds and CAS Numbers

Lead	7439-92-1
Lead (II) sulfate	7446-14-2
Lead (II) carbonate	598-63-0
Lead hydrocarbonate	1319-46-6
Lead acetate	301-04-2
Lead (II) acetate, trihydrate	6080-56-4
Lead phosphate	7446-27-7
Lead selenide	12069-00-0
Lead (IV) oxide	1309-60-0
Lead (II,IV) oxide	1314-41-6
Lead (II) sulfide	1314-87-0
Lead (II) oxide	1317-36-8
Lead (II) carbonate basic	1319-46-6
Lead hydroxidcarbonate	1344-36-1
Lead (II) phosphate	7446-27-2
Lead (II) chromate	7758-97-6
Lead (II) titanate	12060-00-3
Lead sulfate, sulphuric acid, lead salt	15739-80-7
Lead sulphate, tribasic	12202-17-4
Lead stearate	1072-35-1
Other lead compounds	-

Table G - Mercury and its Compounds

Example compounds and CAS Numbers

Mercury	7439-97-6
Mercuric chloride	33631-63-9
Mercury (II) chloride	7487-94-7
Mercuric sulfate	7783-35-9
Mercuric nitrate	10045-94-0
Mercuric (II) oxide	21908-53-2
Mercuric sulfide	1344-48-5
Other mercury compounds	-

Table H - Nickel and its Compounds

Example compounds and CAS Numbers

Nickel	7440-02-0
Nickel acetate	373-02-4
Nickel carbonate	3333-67-3
Nickel carbonyl	13463-39-3
Nickel hydroxide	12054-48-7 or 11113-74-9
Nickelocene	1271-28-9
Nickel oxide	1313-99-1
Nickel subsulfide	12035-72-2
Other nickel compounds	-

Table I – Polybrominated Biphenyls (PBBs) and their Ethers/ Oxides (PBDEs)

Example compounds and CAS Numbers

Bromobiphenyl and its ethers	2052-07-5 (2-Bromobiphenyl) 2113-57-7 (3-Bromobiphenyl) 92-66-0 (4-Bromobiphenyl) 101-55-3 (ether)
Decabromobiphenyl and its ethers	13654-09-6 1163-19-5 (ether)

Dibromobiphenyl and its ethers	92-86-4 2050-47-7 (ether)
Heptabromobiphenylether	68928-80-3
Hexabromobiphenyl and its ethers	59080-40-9 36355-01-8 (hexabromo-1,1'-biphenyl) 67774-32-7 (Firemaster FF-1) 36483-60-0 (ether)
Nonabromobiphenylether	63936-56-1
Octabromobiphenyl and its ethers	61288-13-9 32536-52-0 (ether)
Pentabromobidphenyl ether (note: Commercially available PeBDPO is a complex reaction mixture containing a variety of brominated diphenyloxides.	32534-81-9 (CAS number used for commercial grades of PeBDPO)
Polybrominated Biphenyls	59536-65-1
Tetrabromobiphenyl and its ethers	40088-45-7 40088-47-9 (ether)
Tribromobiphenyl ether	49690-94-0

Table J - Polychlorinated Biphenyls (PCBs) and Terphenyls (PCTs)

Example compounds and CAS Numbers

Polychlorinated Biphenyls	1336-36-3
Aroclor	12767-79-2
Chlorodiphenyl (Aroclor 1260)	11096-82-5
Kanechlor 500	27323-18-8
Aroclor 1254	11097-69-1
Terphenyls	26140-60-3

Table K – Azo colorants (aromatic amines that may be formed by azo dyes)

Example compounds and CAS Numbers

biphenyl-4-ylamine	92-67-1
benzidine	92-87-5
4-chloro-o-toluidine	95-69-2
2-naphthylamine	91-59-8
o-aminoazotoluene	97-56-3
5-nitro-o-toluidine	99-55-8
4-chloroaniline	106-47-8
4-methoxy-m-phenylenediamine	615-05-4
4,4'-methylenedianiline	101-77-9
3,3'-dichlorobenzidine	91-94-1
3,3'-dimethoxybenzidine	119-90-4
3,3'-dimethylbenzidine	119-93-7
4,4'-methylenedi-o-toluidine	838-88-0
6-methoxy-m-toluidine	120-71-8
4,4'-methylene-bis(2-chloroaniline)	101-14-4
4,4'-oxydianiline	101-80-4
4,4'-thiodianiline	139-65-1
o-toluidine	95-53-4
4-methyl-m-phenylenediamine	95-80-7
2,4,5-trimethylaniline	137-17-7
o-anisidine	90-04-0
4-amino azobenzene	

Table L – Halogenated flame retardants/additives (other than PBBs or PBDEs)

Example compounds and CAS Numbers

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-alltl-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-bis85,6-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
Dibromo-styrene grafted PP	171091-06-8
Poly-dibromo-styrene	31780-26-4
Bromo-/Chloro-paraffins	68955-41-9
Bromo-/Chloro-alpha-olefin	82600-56-4
Vinylbromide	593-60-2
Tris-(2,3-dibromo-propyl)-isocyanurate	52434-90-9

Tris(2,4-Dibromo-phenyl) phosphate	49690-63-3
Tris(tribromo-neopentyl) phosphate	19186-97-1
Chlorinated and brominated phosphate ester	125997-20-8
Pentabromo-toluene	87-83-2
Pentabromo-benzyl bromide	38521-51-6
1,3-Butadiene homopolymer, brominated	68441-46-3
Pentabromo-benzyl-acrylate, monomer	59447-55-1
Pentabromo-benzyl-acrylate, polymer	59447-57-3
Decabromo-diphenyl-ethane	84852-53-9
Tribromo-bisphenyl-maleinimide	59789-51-4
Brominated trimethylphenyl-lindane	59789-51-4
Other Brominated Flame Retardants	-
Hexabromo-cyclo-dodecane (HBCD), unspecified	3194-55-6
Tetrabromo-chyclo-octane	31454-48-5
1,2-Dibromo-4-(1,2 dibromo-methyl)-cyclo-hexane	3322-93-8
TBPA Na salt	25357-79-3
Hexabromocyclododecane (HBCDD)	25637-99-4
Tetrabromo phthalic anhydride	632-79-1

Table M – Tributyl tin (TBT) and Triphenyl tin (TPT)

Example compounds and CAS Numbers

Tributyl tin bromide	1461-23-0
Tributyl tin oxide	56-35-9
Tributyl tin acetate	56-36-0
Tributyl tin laurate	3090-36-6
Tributyl tin fluoride	1983-10-4
Triphenyl tin	668-34-8
Triphenyl tin chloride	639-58-7
Triphenyl tin hydroxide	76-87-9
Triphenyl tin acetate	900-95-8
Triphenyl tin fluoride	1983-10-4

Table N – Polychlorinated Naphthalene (PCN)

Example compounds and CAS Numbers

Trichloronaphthalene	1321-65-9
Tetrachloronaphthalene	1335-88-2
Pentachloronaphthalene	1321-64-8
Octachloronaphthalene	2234-13-1

Table O – Perfluorooctane sulfonates (PFOS)

Example compounds and CAS Numbers

Perfluorooctanesulfonyl fluoride	307-35-7
2-Propenoic acid, 2-methyl-, 2-[ethyl[(heptadecafluorooctyl)sulfonyl]amino] ethyl ester	376-14-7
2-Propenoic acid, 2-[butyl[(heptadecafluorooctyl)sulfonyl]amino]ethyl ester	383-07-3
2-Propenoic acid, 2-[ethyl[(heptadecafluorooctyl)sulfonyl]amino]ethyl ester	423-82-5
N-allylheptadecafluorooctanesulphonamide	423-86-9
heptadecafluorooctanesulphonamide	754-91-6

1-Propanaminium, 3-[[[(heptadecafluorooctyl)sulfonyl]amino]-N,N,N-trimethyl-, iodide	1652-63-7
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Table P – Polycyclic Aromatic Hydrocarbons (PAH)

Example compounds and CAS Numbers

Anthracene	120-12-7
Benzo[a]pyrene	50-32-8
Chrysene	218-01-9
Coronene	191-07-1
Corannulene	5821-51-2
Naphthacene	92-24-0
Naphthalene	91-20-3
Pentacene	135-48-8
Phenanthrene	85-01-8
Pyrene	129-00-0
Triphenylene	217-59-4
Ovalene	190-26-1

Table Q – Fluorinated Greenhouse Gases

Example compounds and CAS Numbers

Carbon tetrafluoride (Perfluoromethane)	75-73-0
Perfluoroethane (Hexafluoroethane)	76-16-4
Perfluoropropane (Octafluoropropane)	76-19-7
Perfluorobutane (Decafluorobutane)	355-25-9
Perfluoropentane (Dodecafluoropentane)	678-26-2
Perfluorohexane (Tetradecafluorohexane)	355-42-0
Perfluorocyclobutane	115-25-3
Sulfur Hexafluoride (SF6)	2551-62-4
HFC-23 CHF3	75-46-7
HFC-32 CH2F2	75-10-5
HFC-41 CH3F	593-35-3
HFC-43-10mee C5H2F10	138495-42-8
HFC-125 C2HF5	354-33-6
HFC-134 C2H2F4	359-35-3
HFC-134a CH2FCF3	811-97-2
HFC-152a C2H4F2	75-37-6
HFC-143 C2H3F3	430-66-0
HFC-143a C2H3F3	420-46-2
HFC-227ea C3HF7	431-89-0
HFC-236cb CH2FCF2CF3	677-56-5
HFC-236ea CHF2CHF2CF3	431-63-0
HFC-236fa C3H2F6	690-39-1
HFC-245ca C3H3F5	679-86-7
HFC-245fa CHF2CH2CF3	460-73-1
HFC-365mfc CF3CH2CF2CH3	406-58-6

Table R – Radioactive Substances

Example compounds and CAS Numbers

Uranium-238	7440-61-1
Radon	10043-92-2
Americium-241	14596-10-2
Thorium-232	7440-29-1

Cesium (Radioactive Isotopes only)	7440-46-2 (Cs-137 010045-97-3)
Strontium (Radioactive Isotopes only)	(elemental 7440-29-6) (Sr-90 10098-97-2)
Other radioactive substances	-

Table S – Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins) (SCCPs)

Example compounds and CAS Numbers

Alkanes, C10-13, chloro	85535-84-8
Alkanes, C10-12, chloro	108171-26-2
Alkanes, C12-13, chloro	71011-12-6
Alkanes, chloro	61788-76-9
Chlorinated polyethylene	64754-90-1
Other Short Chain Chlorinated Paraffins	-

Table T – Dibutyltin (DBT) and Dioctyltin (DOT) Compounds

Example compounds and CAS Numbers

Dibutyltin oxide	818-08-6
Dibutyltin diacetate	1067-33-0
Dibutyltin dilaurate	77-58-7
Dibutyltin maleate	78-04-6
Other dibutyltin compounds	-
Dioctyl Tin Oxide	870-08-6
Dioctyltin dilaurate	3648-18-8
Other Dioctyltin compounds	-