

Engineering Specification - Compliance Requirements for the European Union Directive (and other jurisdictions) on the Restriction of the Use of Certain Hazardous Substances (RoHS) in Electrical and Electronic Equipment for IBM Products

Note: This specification allows the exemption “Lead in solders for servers, storage and storage array systems.”

PN 53P6233

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Written by:	Debbie Horn Environmental Product Stewardship IBM Systems and Technology Group (STG) Telephone (507) 253-5132 dnh@us.ibm.com	4 May 2009
Reviewed and Approved by:	Derrick Scott Manager, Environmental Compliance and Software Tools IBM Systems and Technology Group Development	4 May 2009

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1.0 Scope

1.1 Objectives

This Deliverable must comply with the European Union Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment and with the requirements in this specification. This specification release reflects the revised exemption status as recommended by the Öko-Institut e.V. Final Report - Adaptation to scientific and technical progress under Directive 2002/95/EC, February 20, 2009.

In order to comply with this Directive, this Deliverable must not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBBs) and/or polybrominated diphenyl ethers (PBDEs) in some cases above certain levels. See Sections 2.2, 2.3, and 2.4 for more specific information on exemptions and allowable substitute materials.

In addition to this specification, IBM maintains other environmental specifications for Deliverables, for example, IBM Engineering Specification 46G3772 - Baseline Environmental Requirements for Supplier Deliverables to IBM. See Section 3 for details and web site location. Where multiple documents exist which contain requirements for the same Deliverable, the most restrictive requirement applies.

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1.2 Definitions

Deliverable(s) - any tangible item(s) delivered by or for a Supplier to IBM in accordance with a purchase contract or other agreement with IBM. Deliverables include, but are not limited to, components, Materials, Parts, Products and tools. See Section 1.3 for specific information about tools and consumable items.

Homogeneous Material - a unit that cannot be mechanically disjointed into single materials, or any material that is not mechanically divisible (disassembled, cut or ground) into separate material constituents. Mechanically disjointed means the materials can be, in principle, separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes. For example, a plastic cover is a “Homogeneous Material” if it consists of one type of plastic that is not coated with or has attached to it or inside it any other kinds of materials. In this case, the limit values found in Table 1 would apply to the plastic. An electric cable that consists of metal wires surrounded by nonmetallic insulation materials is an example of a “nonhomogeneous material” because the different materials could be separated by mechanical processes. In this case, the limit values found in Table 1 would apply to each of the separated materials. A semiconductor package contains many homogeneous materials which include plastic molding material, tin-electroplating coatings on the lead frame, the lead frame alloy and gold-bonding wires. Homogeneous is understood to be of uniform composition throughout.

Intentionally Added or Intentional Addition - a substance is deliberately utilized in the production of a Deliverable.

Materials - chemical substances and preparations that are supplied for the production of Parts, Products and other items (e.g., structural plastics, metals, coatings, paints, and adhesives) and chemical substances or preparations that are shipped with Parts or Products, such as toner, cleaners, lubricants, oils, and refrigerants.

Not Detected - below the detection limit of established test standards or appropriate industry wide test methods. In general, these test standards/ methods should achieve trace level detection or at the lowest detection capabilities of the specific sample matrix.

Parts - fabricated Materials, components, devices and assemblies.

Products - stand alone, final assemblies including complete machines supplied by an original equipment manufacturer (OEM).

RoHS - an acronym for the European Union (EU) Directive 2002/95/EC on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment and subsequent amendments to this Directive.

http://ec.europa.eu/environment/waste/weee/legis_en.htm

1.3 Application and Verification

This engineering specification applies to all Deliverables supplied for IBM Server and Storage products, which have this specification cited on their respective IBM part number drawings, part or product specifications, procurement agreements, purchase contracts, purchase orders or other procurement documentation. The supplier is responsible for compliance with this specification as well as for any subcontracted operations and procured Parts, Materials, Products or assemblies used in the manufacture of Deliverables for IBM Server and Storage applications. Upon request by IBM, the supplier will verify via analytical testing, compliance to this specification. Supplier may use analytical techniques to confirm results. Please refer to the document - IBM Systems and Technology Group (STG) RoHS Analysis Guideline SG-D-0417 located at:

<http://www-03.ibm.com/procurement/proweb.nsf/ContentDocsByTitle/United+States~Information+for+suppliers>

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This specification does not apply to consumable items such as ink cartridges, CDs, DVDs, floppy disks, tape cartridges, non-electrical tools (e.g., hammers, screwdrivers, ladders), customer instruction manuals or product packaging materials (e.g., cardboard and wood pallets). Electrical and electronic tools (with the exception of large-scale stationary industrial tools) are included within the scope of the EU RoHS Directive. RoHS compliance requirements for electrical and electronic tools for IBM products (e.g., electronic drills, electronic tools for welding, soldering, riveting, nailing or screwing) are addressed in specification 97P3864.

Deviation from the requirements of this specification must have prior written approval by IBM's procurement representative. IBM Procurement shall obtain the documented consent from the appropriate IBM representatives. IBM Procurement must contact the author of this document for details on the documentation requirements for deviations.

Deviations from this specification for OEM products (not branded by IBM nor installed inside IBM-branded products) require written approval from the IBM Procurement Product Brand Manager.

1.4 Document Administration

This document is maintained and controlled by IBM Systems and Technology Group.

2.0 Requirements

2.1 Substances Prohibited From Use

The EU RoHS Directive and legal requirements in other jurisdictions ban the use of the following in new electrical and electronic products:

- **Lead (Pb),**
- **Mercury (Hg),**
- **Cadmium (Cd),**
- **Hexavalent chromium (Cr⁺⁶),**
- **Polybrominated biphenyl (PBB) flame retardants and**
- **Polybrominated diphenyl ether (PBDE) flame retardants.**

This prohibition applies to the above substances and all compounds containing these substances. These substances and compounds must not be in or on any Deliverable except for the exemptions listed in Section 2.2 or in the allowed concentrations found in Table 1 below. The maximum allowable level found in a Homogeneous Material (e.g., metal, adhesive, paint, plastic, plating), cannot exceed the levels found in the table below. Please note: these substances, generally in specific applications, have more restrictive requirements than those cited by the EU RoHS Directive. Please refer to IBM Engineering Specification 46G3772 for more restrictive requirements for all of the RoHS substances.

Table 1. EU RoHS Maximum Concentration Values(MCV)

Substance	RoHS Maximum Concentration Value in a Homogeneous Material- % by weight or (ppm)	Additional application restrictions may apply. See IBM specification 46G3772 for more details.
Lead (Pb)	0.1% or 1,000 ppm	Specific applications have more restrictive levels.

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Mercury (Hg)	0.1% or 1,000 ppm	Any detectable level must be reported, except unavoidable impurities at levels below 10ppm.
Cadmium (Cd)	0.01% or 100ppm	Any detectable level must be reported for plating and surface coating applications.
Hexavalent chromium (Cr ⁺⁶)	0.1% or 1,000 ppm	Specific applications have more restrictive levels.
Polybrominated biphenyl (PBB) flame retardants	0.1% or 1,000 ppm	Any detectable level must be reported.
Polybrominated diphenyl ether (PBDE) flame retardants. Note: IBM includes Decabromo diphenyl ether in this category.	0.1% or 1,000 ppm	Any detectable level must be reported.

There are other jurisdictions, other than the EU Member States, with RoHS types of requirements. The list below is not complete and is provided for information only. In some jurisdictions the product scope and requirements are different from the scope and requirements of the EU Directive. Deliverables to IBM which cite this specification must meet the requirements of this specification irrespective of the jurisdiction where the Deliverable is transferred to IBM.

- States of California and Rhode Island,
- New York City,
- People's Republic of China,
- European Free Trade Association Countries,
- EU Candidate Countries - Croatia and Turkey, and
- Korea.

2.2 Exemptions

The following are the applications which are exempt from the requirements of RoHS as cited by the EU Directive, subsequent amendments and the Öko-Institut e.V. Final Report Adaptation to scientific and technical progress under Directive 2002/95/EC, February 20, 2009

(http://ec.europa.eu/environment/waste/weee/pdf/final_report1_rohs1_en.pdf). The expiration date, as listed by the Öko-Institut Report is cited in the second column. The prohibition, as stated in Section 2.1, is in place for all other applications. The numbering scheme used below reflects the numbering of the exemptions as listed by the RoHS Directive, amendments and the February 20, 2009 report. IBM has determined some of the exemptions will not be allowed for IBM products. This information is noted by the number. Where specified by IBM in the procurement documents some of these exemptions may still be used when the order is for the repair and reuse of equipment put on the market by specific dates noted in Appendix B. Five exemptions, 8a, 11a, 12, 14, 22 and 23 are not allowed for IBM part numbers for Deliverables released after May 4, 2009. A follow-on release of this specification will prohibit the use of these exemptions with provisions as allowed by the EU Directive, for spare parts for products put on the market by specific dates.

Please note, at this time, the report from Öko-Institut has similar wording for exemptions 5c and 7c1. See their report at the web site provided above for clarifications.

Table 2. RoHS Exemptions

No.	Expiration Date	Exemption
1		Mercury in single capped fluorescent lamps not exceeding (per burner):
1a	July 31, 2014	For general lighting purposes < 50 Watts: 3.5 mg,
1b	July 31, 2014	For general lighting purposes ≥ 50 Watts and < 150 Watts: 5 mg,

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1c	December 31, 2012	For general lighting purposes >150 Watts: 15 mg,
1d	July 31, 2014	For general lighting purposes with circular or square structural shape and tube diameter ≤ 17 mm: 7 mg,
1e	July 31, 2014	For special purposes: 5 mg.
2a		Mercury in double-capped linear fluorescent lamps for general purposes not exceeding
2a-I	July 31, 2014	Tri-band phosphor with normal lifetime T2: 4 mg,
2a-II	July 31, 2014	Tri-band phosphor with normal lifetime $> T2$ and $\leq T5$: 3 mg,
2a-III	July 31, 2014	Tri-band phosphor with normal lifetime $> T5$ and $\leq T8$ and < 183 cm: 3.5 mg,
2a-IV	July 31, 2014	Tri-band phosphor with normal lifetime $> T8$ and $\leq T12$: 3.5 mg,
2a-V	July 31, 2014	Tri-band phosphor with long lifetime: 5 mg.
2b		Mercury in other fluorescent lamps not exceeding:
2b-I	July 31, 2014	Halophosphates all shapes: 8 mg,
2b-II	July 31, 2014	T5 non-linear tri-band phosphor lamps: 8 mg,
2b-III	July 31, 2014	T9 non-linear tri-band phosphor lamps: 15 mg,
2b-IV	July 31, 2014	Induction lamps: 15 mg.
3		Mercury in cold cathode fluorescent lamps (CCFL):
3a	December 31, 2012	Mercury in short length (not over 500 mm) CCFL and external electrode fluorescent lamps (EEFL) not exceeding 3.5 mg per lamp,
3b	December 31, 2012	Mercury in medium length (over 500 mm and not over 1500 mm) CCFL and EEFL not exceeding 5 mg per lamp,
3c	December 31, 2012	Mercury in long length (over 1500 mm) CCFL and EEFL not exceeding 13 mg per lamp.
4a-I		Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding in lamps with improved colour rendering index > 60 :
4a-Ia	July 31, 2014	$P \leq 155$ W: 30 mg per burner,
4a-Ib	July 31, 2014	$155 < P \leq 405$ W: 40 mg per burner,
4a-Ic	July 31, 2014	$P > 405$ W: 40 mg per burner.
		Mercury in high pressure sodium (vapour) lamps for general lighting purposes not exceeding in other High Pressure Sodium (vapour) lamps:
4a-Id	July 31, 2014	$P \leq 155$ W: 25 mg per burner,
4a-Ie	July 31, 2014	$155 < P \leq 405$ W : 30 mg per burner,
4a-If	July 31, 2014	$P > 405$ W: 40 mg per burner.
4a-II	July 31, 2014	Mercury in High Pressure Mercury (Vapour) lamps except for general lighting (HPMV).
4a-III	July 31, 2014	Mercury in Metal halide lamps (MH).
4b	July 31, 2014	Mercury in other discharge lamps for special purpose not specifically mentioned in this Annex.
5a	July 31, 2014	Lead (Pb) in the glass of cathode ray tubes.
5b	July 31, 2014	Lead (Pb) in the glass of fluorescent tubes not exceeding 0.2% by weight
5c	July 31, 2014	Electrical and electronic components which contain lead (Pb) in a glass or ceramic other than a dielectric ceramic, or in a glass or ceramic matrix compound (e.g., piezoelectronic devices).
6a	December 31, 2013	Lead (Pb) as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight.
6b	December 31, 2013	Lead (Pb) as an alloying element in aluminum containing up to 0.4% lead by weight.
6c	December 31, 2013	Copper alloy containing up to 4% lead by weight.
7a	June 30, 2013	Lead (Pb) in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead).
7b	July 31, 2014	Lead (Pb) in solders for servers, storage and storage array systems, network

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		infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications.
7c-I	July 31, 2014	Electrical and electronic components which contain lead (Pb) in a glass or ceramic other than a dielectric ceramic, or in a glass or ceramic matrix compound (e.g. Piezoelectronic devices).
7c-II	July 31, 2014	Electrical and electronic components for a voltage of 125V AC or 250V DC or higher which contain lead (Pb) in a dielectric ceramic.
7c-III	December 31, 2012	Electrical and electronic components for a voltage of less than 125V AC or 250V DC which contain lead (Pb) in a dielectric ceramic.
8a	<u>This exemption is not allowed for IBM part number Deliverables released after May 4, 2009.</u>	Cadmium and its compounds in one shot pellet type thermal cut-offs.
8b	July 31, 2014	Cadmium and its compounds in electrical contacts.
9	December 31, 2013	Hexavalent chromium as an anticorrosion agent of the carbon steel cooling system in absorption refrigerators up to 0.75 weight- % in the cooling solution except for applications where the use of other cooling technologies is practicable (e.g., available on the market for the specific area of application) and does not lead to negative environmental, health and/or consumer safety impacts.
9a	<u>This exemption is not allowed IBM Deliverables.</u>	DecaBDE in polymeric applications (expired June 30, 2008).
9b	July 31, 2014	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for HVACR (Heating, Ventilation, Air Conditioning & Refrigeration) applications.
11a	<u>This exemption is not allowed for IBM part number Deliverables released after May 4, 2009.</u>	Lead (Pb) used in C-press compliant pin connector systems.
11b	December 31, 2012	Lead (Pb) used in other than C-press compliant pin connector systems.
12	<u>This exemption is not allowed for IBM part number Deliverables released after May 4, 2009.</u>	Lead (Pb) as a coating material for the thermal conduction module C-ring.
13a	July 31, 2014	Lead (Pb) in white glasses used for optical applications.
13b	July 31, 2014	Cadmium and lead (Pb) in filter glasses.
14	<u>This exemption is not allowed for IBM part number Deliverables released after May 4, 2009.</u>	Lead (Pb) 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.
15	July 31, 2014	Lead (Pb) in solders to complete a viable electrical connection between

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		semiconductor die and carrier within integrated circuit flip chip packages.
16	<u>This exemption is not allowed for IBM Deliverables.</u>	Lead (Pb) in linear incandescent lamps with silicate coated tubes.
17	July 31, 2014	Lead (Pb) halide as radiant agent in High Intensity Discharge (HID) lamps used for professional reprography applications.
18	July 31, 2014	Lead (Pb) 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).
19	<u>This exemption is not allowed for IBM Deliverables.</u>	Lead (Pb) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with P ₂ Sn-Hg as auxiliary amalgam in very compact Energy Saving Lamps (ESL).
20	<u>This exemption is not allowed for IBM Deliverables.</u>	Lead (Pb) oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCD.)
21	July 31, 2014	Lead (Pb) and Cadmium (Cd) in printing inks for the application of enamels on borosilicate glass.
22	<u>This exemption is not allowed for IBM part number Deliverables released after May 4, 2009.</u>	Lead (Pb) as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems.
23	<u>This exemption is not allowed for IBM part number Deliverables released after May 4, 2009.</u>	Lead (Pb) in finishes of fine pitch components other than connectors with a pitch of 0.65 mm and less.
24	July 31, 2014	Lead (Pb) in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors.
25	July 31, 2014	Lead (Pb) oxide in surface conduction electron emitter displays (SED) used in structural elements; notably in the seal frit and frit ring.
26	<u>This exemption is not allowed for IBM Deliverables.</u>	Lead (Pb) oxide in the glass envelope of Black Light Blue (BLB) lamps.
27	<u>This exemption is not allowed for IBM Deliverables.</u>	Lead (Pb) 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.
28	<u>This exemption is not allowed for IBM Deliverables.</u>	Exemption expired July 1, 2007.
29	July 31, 2014	Lead (Pb) bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC.
30	No expiration	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located

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	date at this time.	directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more.
31	No expiration date at this time.	Lead (Pb) in soldering materials in mercury free flat fluorescent lamps (which e.g. Are used for liquid crystal displays, design or industrial lighting.)
32	No expiration date at this time..	Lead (Pb) oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes.

Batteries are exempt from the EU RoHS Directive but have their own requirements for material restrictions in other EU Directives and legal requirements in other jurisdictions. See IBM Engineering Specification 46G3772 for material restrictions for batteries.

2.3 Lead (Pb) and Lead (Pb) Compounds

2.3.1 Acceptable Lead (Pb) - Free Finishes for Electronic Components

The table below lists finishes that are acceptable per this specification. Finishes not designated in the following table may be acceptable pending review and approval by IBM Development Engineering. Contact IBM Procurement Engineering for information about this review. Typical applications include, but are not limited to, lead-frames, heat sinks, and connectors. The minimum tin, or tin alloy, thickness is determined by the application.

Table 3. Acceptable Finishes for Electronic Components

Finish	Notes
Palladium-Nickel (PdNi) with gold (Au) flash	For connectors, gold (Au) flash is 5-10 microinches.
Palladium-Nickel (PdNi) without gold (Au) flash	For connectors, IBM approval is required if gold (Au) flash is omitted from the mating or termination areas.
Fused , dipped, or reflowed 100% Tin (Sn) or Tin (Sn) Alloys	Acceptable without additional mitigation. Alloying elements include silver (Ag), bismuth (Bi), copper (Cu), zinc (Zn), and nickel (Ni).
Tin over nickel underlay (Sn/Ni)	Connectors require 1.25 microns nickel (Ni) thickness. Non-connector applications require 1.0 micron minimum nickel (Ni) thickness. Nickel (Ni) films with less than 1.0 micron thickness require IBM Development Engineering approval. Both bright and matte tins are acceptable with Nickel (Ni) underlay.
Annealed Tin (Sn) (matte, bright, or alloyed) over copper (Cu) base metal	Annealing temperature must be greater than 120°C for one hour or more. Annealing must occur within two weeks after plating. Anneal is not required if lead/pin pitch is > 1mm. For connectors: no forming after annealing
Tin (Sn) over Alloy 42 (Fe/Ni) base metal, with or without Copper (Cu) underlay.	Annealing is not required.
Tin alloy: Tin-Bismuth (SnBi) Nominal Bismuth (Bi) concentration: 2 - 4%. Total Bismuth (Bi) range: 1 - 5%.	All other Bismuth (Bi) contents require IBM approval. Acceptable over copper, nickel, and Alloy 42 (FeNi). For connectors, specific IBM approval required for any Tin-bismuth (SnBi) usage.
Tin alloy: Tin-Silver (SnAg). Minimum Silver (Ag) concentration: 1%	All other silver (Ag) contents require IBM approval. Acceptable over copper, nickel, and Alloy 42 (FeNi)
Tin alloy Tin-Copper (SnCu) annealed over a copper (Cu) base metal and Tin-copper (SnCu) over Nickel (Ni) underlay	Tin-copper (SnCu) over Copper (not annealed), and Tin-copper (SnCu) over Alloy 42 (FeNi) are not unconditionally acceptable as a finish. Requires IBM Development Engineering approval.
Noble Metals: Gold (Au)	For connector applications there must be a nickel underlay. The gold (Au) thickness is determined by the application.
Noble Metals: Silver (Ag)	All silver (Ag) finishes require IBM Development Engineering approval.

Immersion Tin	Does not require additional mitigation. Has been approved for heat sinks. Requires approval based on test data.
Nickel (Ni)	Unconditionally acceptable for non-soldered surfaces, generally very difficult to solder.

Solderable finishes which are conditionally acceptable, are listed in IBM Procurement Specification 873444.

2.3.2 Printed Circuit Boards

All PCB soldering to be eutectic tin-lead (SnPb) solder unless otherwise approved by IBM. Contact IBM Procurement Engineering for information on the processes for approval of alternative solders.

Except for the specific exemptions listed in Section 2.2, printed circuit boards must not contain lead (Pb) in amounts greater than those shown in Table 1, including printed circuit board finishes. The RoHS-compatible finishes listed in the table below must also pass further IBM standard qualifications outside the scope of this specification. IBM-designed cards using the finishes listed below, require approval from IBM Printed Circuit Board (PCB) Procurement Engineering.

Table 4. RoHS-Compatible Surface Finish Materials for Printed Circuit Boards

Finish	Notes
Immersion Tin	Requires approval from IBM PCB Procurement Engineering
Organic Solderability Preservatives (OSPs)	Preferred, for example benzotriazole (BTA). Refer to IBM Procurement Specification 53P4082 for guidelines in selecting the appropriate OSP.
HASL (Hot Air Solder Leveled) Tin or Tin Alloy	Requires approval from IBM PCB Procurement Engineering
Immersion Silver	Requires approval from IBM PCB Procurement Engineering
Electroless Nickel Immersion Gold	Requires approval from IBM PCB Procurement Engineering.
Electrolytic Nickel with noble metal over plate	Requires approval from IBM PCB Procurement Engineering

2.3.3 Cables and Connectors

Cable assembly components (e.g., jacket material, over molding materials, housings, tapes, shrink tubing, latches, thumbscrews) will be free of lead (Pb) compounds such as lead-based stabilizers and pigments, except where concentrations in the homogeneous material are less than the maximum concentration values cited in Table 1 or have an applicable exemption as cited in Section 2.2.

2.3.4 Acceptable Uses of Leaded (Pb) Solder

The following are considered acceptable uses of lead (Pb) solder in Server and Storage Products at this time. This section is applicable for all Deliverables supplied for IBM Server and Storage products that have this specification cited on their respective IBM part number drawing or in their part specification, purchase contract or purchase order. Any variances from this list require IBM approval. Contact IBM Procurement Engineering for information on approval processes. Please note: these acceptable uses of leaded solders will not be allowed in future releases of this specification, except for the repair and reuse of eligible equipment put on the market prior to 1 August 2014, as the exemption for lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission and network

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management for telecommunications will be phased out in 2014. IBM will phase out the use of this exemption prior to July 31, 2014. It is anticipated that a lead time of six to 24 months will be required to phase out the listed uses below.

- Light crimp and solder of connector terminals.
- Solder of copper tape over premold prior to overmold (for shielding).
- Solder dip wires prior to soldering.
- Solder dip buss bars prior to soldering.
- Solder applied to specific printed circuit board pads or plated through holes during processes that result in the attachment of electrical or mechanical components to these specific sites on the printed circuit board.
- Soldering of connectors, wires, and components to printed circuit boards (PCBs) in cable assemblies.
- Splices (usually used to create a jumper to eliminate double/triple crimps or light crimp and solder situations).
- Soldering of wires directly to terminals.
- Solder cup terminals.
- Soldering of braid and drain wires for ground connections.
- All solder bumps/balls and solder column technology must remain leaded (Pb) unless approved by IBM. Tin/lead (SnPb) balls containing 2% silver (Ag) are acceptable.
- As a finish for all termination based components (e.g. Chip capacitors, chip resistors, QFN, DFN) where the entire termination is covered by solder during the reflow soldering process.
- Solder/brazing of fins to heatsinks.

2.3.5 Acceptable Non-lead(Pb) Solders for Paste, Wave and Rework Solder

Use of non-lead (Pb) solders for paste, wave, rework, and assembly requires approval from IBM Procurement Engineering.

2.4 Hexavalent Chromium (Cr +6) and Hexavalent Chromium (Cr +6) Compounds

Hexavalent chromium and its compounds must not be used in finishing processes for sheet steel, aluminized, electroless nickel and die cast parts, fasteners and heatsinks. Hexavalent chromium and its compounds must not be used prior to painting or in other surface treatments for metal parts.

2.4.1 Acceptable Substitutes for Metal Finishes

Acceptable substitutes for hexavalent chromium finishes may include but are not limited to the list below. Note: The following list cites finishes that are compliant to RoHS requirements. Other requirements such as aesthetics may be necessary for parts. The part print is the master document which cites the material code to be used.

- IBM Material Code 06-091D, E and F: Hot dip galvanized steel sheet without chromate,
- IBM Material Code 06-091H: Steel, galvanized, commercial quality, coating designation Z120/G30, hot dipped galvanized, minimum spangled, temper passed (extra smooth) with hexavalent chromium-free chemical treatment, not oiled
- IBM Material Codes 06-131C: Steel, low carbon, commercial quality, electrogalvanized with hexavalent chromium-free chemical treatment, class B (ASTM A591),
- IBM Material Codes 07-xxx: Steels, alloy.
- IBM Material Code 41-020 - Nickel plating
- IBM Material Code 41-027: Nickel-phosphorous electroless plating; specify thickness and class: decorative (alphabetic) and heat-treat (numeric). Post-plating processes which may include hexavalent chromium compounds are not permitted. Note: After 12/01/04, all electroless nickel bath chemistries must not employ Lead (Pb) or Cadmium (Cd) compounds in their formulation in order to meet projected RoHS requirements.
- IBM Material Code 41-091 Type 2A: Zinc plating, black, 5-10 micrometers zinc with Type 2 black chromate must be hexavalent chromium-free, 0.7 grams per square meter,
- IBM Material Code 41-091 Type 3: Zinc plating, black, non-conductive black finish,
- IBM Material Code 41-093: Zinc plating, includes supplementary yellow or clear chromate conversion coating as specified below:

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- Type 1A: 5 micrometers zinc minimum with yellow iridescent chromate conversion coating which must be hexavalent chromium-free,
- Type 2A: 5 micrometers zinc minimum with clear chromate conversion coating which must be hexavalent chromium-free,
- Type 3A: (for thread-forming fasteners) 5-8 micrometers nickel alloy, 5-8 micrometers zinc with yellow iridescent coating which must be hexavalent chromium-free,
- IBM Material Code 41-217A: Hexavalent chromium-free chromate conversion coating: tan on aluminum alloys,
- IBM Material Code 41-218A, Hexavalent chromium-free chromate conversion coating: clear on aluminum alloys,
- IBM Material Code 41-219A, Hexavalent chromium- free conversion coating for magnesium alloys,
- IBM Material Code 41-225A, Hexavalent chromium-free conversion coating: black on aluminum alloys, 0.45 grams per square meter.
- Steel with electroplated chromium finishes must be reviewed and approved by the IBM Development organization responsible for this hardware application.
- Anodization is considered to be a compliant process.
- IBM Material Code 61-0956 Electro-coating process, Black

IBM Material Code information can be found at:<http://bomdetail.services.ibm.com/matcodes/matcodes.nsf>

Note: Multiple IBM Material Codes have cited a specific ASTM standard at the above web address. Certification to that standard is acceptable verification of compliance to this specification.

2.4.2 Base Materials

The following are considered to be compliant to this specification and RoHS as long as the lead (Pb) content does not exceed the maximum concentration value referenced in Table 1 - 0.1% by weight in a homogeneous material. There is an additional exemption for the lead (Pb) content in steel, aluminum and copper alloys referenced below, see Section 2.2 for maximum allowable lead (Pb) content in these alloys. Note: future releases of this specification will eliminate the exemptions for lead (Pb) as an alloying element in steel and aluminum and in copper alloys as these exemptions are eliminated by the EU RoHS Directive.

If a surface coating is specified, it must also be compliant with this specification and RoHS. Surface coatings include plating and surface treatments such as passivation of steel. Note: surface coatings are not required for every application of a base metal.

- 06-XXX: Carbon steels that are not RoHS compliant are marked as such in the IBM Materials Bulletin. Surface coatings must be specified and must be RoHS compliant also (see sec. 2.4.1.)
- 07-XXX: Stainless steels.
- 06-080 - Steel, aluminized, type 1 or 2 : either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment.
- 06-081A - Steel, aluminized, type 1, commercial quality, coating designation T1-40: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-081B - Steel, aluminized, type 1, commercial quality, coating designation T1-25: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-082A - Steel, aluminized, type 1, drawing quality, coating designation T1-25: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-082B - Steel, aluminized, type 1, drawing quality, coating designation T1-25: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-083A - Steel, aluminized, type 2, commercial quality, coating designation T2-100: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 06-083B - Steel, aluminized, type 2, commercial quality, coating designation T2-65: either oiled or RoHS compliant chemical treatment; shall not contain any hexavalent chromium (Cr+6) in surface treatment
- 01-XXX: Aluminum and aluminum alloys. Surface coatings must be specified and compliant.
- 03-XXX: Copper and copper alloys. Surface coatings must be specified and compliant.
- 12- XXX: Magnesium and magnesium alloys. Surface coatings must be specified and compliant.
- 15-510, 511 and 512: Titanium and titanium alloys. Surface coatings must be specified and compliant.
- 14-100, 101, 102, 110, 120, 130: Zinc die cast alloys.

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2.5 Cadmium (Cd) and Cadmium (Cd) compounds

Cadmium and its compounds and alloys must not be used in processes for or on IBM Deliverables (except where concentrations on or in the Homogeneous Material are less than the maximum concentration values cited in Table 1) which include but are not limited to the following applications:

- Coloration pigments, for example in cable conductor insulation or cable jacket material.
- Stabilizers, for example in polyvinyl chloride (PVC) cables.

2.6 PBBs and PBDEs

Polybrominated biphenyls and polybrominated diphenyl ethers must not be used in IBM Deliverables which include but are not limited to the following applications:

- Flame retardants in printed circuit boards, components, gasketing and plastic resin parts.

This ban applies to all 209 congeners of PBBs and all 209 congeners of PBDEs including, but not limited to the following:

Polybrominated Biphenyls (PBBs)	Chemical Abstracts Service (CAS) #
2-Bromobiphenyl	2052-07-05
3-Bromobiphenyl	2113-57-7
4-Bromobiphenyl	92-66-0
Decabromobiphenyl	13654-09-06
Dibromobiphenyl	92-86-4
Heptabromobiphenyl	59080-40-9
Hexabromobiphenyl	59080-40-9
Hexabromo-1,1-biphenyl	36355-01-8,
Nonabromobiphenyl	27753-52-2
Octabromobiphenyl	61288-13-9
Pentabromobiphenyl	56307-79-0
Polybrominated Biphenyl	59536-65-1
Tetrabromobiphenyl	40088-45-7
Tribromobiphenyl	59080-34-1
Firemaster FF-1	67774-32-7

Polybrominated Diphenyl Ethers (PBDEs)	CAS #
Bromobiphenyl Ether	101-55-3
Decabromobiphenyl Ether	1163-19-5
Dibromobiphenyl Ether	2050-47-7
Heptabromobiphenyl Ether	68928-80-3
Hexabromobiphenyl Ether	36483-60-0
Nonabromobiphenyl Ether	63936-56-1
Octabromobiphenyl Ether	32536-52-0
Pentabromobiphenyl Ether	32534-81-9
Tetrabromobiphenyl Ether	40088-47-9
Tribromobiphenyl Ether	49690-94-0

3.0 References

California Electronic Waste Recycling Act of 2003. <http://www.ciwm.ca.gov/Electronics/Act2003/>

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Council Directive 76/769/EEC of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations.
http://europa.eu.int/eur-lex/en/consleg/pdf/1976/en_1976L0769_do_001.pdf

Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Official Journal of the European Union 13.2.2003
[Http://europa.eu.int/eur-lex/prl/en/oj/dat/2003/l_037/l_03720030213en00190023.pdf](http://europa.eu.int/eur-lex/prl/en/oj/dat/2003/l_037/l_03720030213en00190023.pdf)

Commission Decision 2005/618/EC of 18 August 2005 amending Directive 2002/95/EC of the European Parliament and of the Council for the purpose of establishing the maximum concentration values for certain hazardous substances in electrical and electronic equipment. [Http://europa.eu.int/comm/environment/waste/weee_index.htm](http://europa.eu.int/comm/environment/waste/weee_index.htm)

Commission Decision 2005/717/EC of 13 October 2005 amending for the purposes of adapting to the technical progress the Annex to Directive 2002/95/EC of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment. [Http://europa.eu.int/comm/environment/waste/weee_index.htm](http://europa.eu.int/comm/environment/waste/weee_index.htm)

Commission Decision 2005/747/EC of 21 October 2005 amending for the purposes of adapting to technical progress the Annex to Directive 2002/95/EC of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment. [Http://europa.eu.int/comm/environment/waste/weee_index.htm](http://europa.eu.int/comm/environment/waste/weee_index.htm)

IBM Engineering Specification 46G3772: Baseline Environmental Requirements for Materials, Parts, and Products for IBM Logo Hardware Products. <http://www.ibm.com/ibm/environment/products/especs.shtml> or <http://www-03.ibm.com/procurement/proweb.nsf/ContentDocsByTitle/United+States~Information+for+suppliers>

IBM Information for Suppliers web site:

<http://www-1.ibm.com/procurement/proweb.nsf/ContentDocsByTitle/United+States~Information+for+suppliers>

IBM Material Codes Directory. <http://bomdetail.services.ibm.com/matcodes/matcodes.nsf>

Louisiana Mercury Risk Reduction Act of 2006 <http://www.legis.state.la.us/billdata/streamdocument.asp?did=399136>

New Jersey Electronic Waste Recycling Act http://www.njleg.state.nj.us/2006/Bills/PL07/347_..PDF

New York City Local Law 120 - Hazardous Substances: http://www.nycouncil.info/pdf_files/bills/law05120.pdf

Norway Product Control Regulation Chapter 2. Restricted Substances and Preparations
http://www.sft.no/seksjonsartikkel_30217.aspx

Öko-Institut e.V. Final Report Adaptation to scientific and technical progress under Directive 2002/95/EC, February 20, 2009
[Http://ec.europa.eu/environment/waste/weee/pdf/final_reportl_rohs1_en.pdf](http://ec.europa.eu/environment/waste/weee/pdf/final_reportl_rohs1_en.pdf)

People's Republic of China - Management Methods for Controlling Pollution by Electronic Information Products
 Chinese: http://www.mii.gov.cn/art/2006/03/02/art_521_7344.html
 English: http://www.aeanet.org/governmentaffairs/gabl_ChinaRoHS_FINAL_March2006.asp

People's Republic of China - Ministry of Information Industry - Electronic Information Products Classification and Explanation
 Chinese: http://www.mii.gov.cn/art/2006/03/16/art_1221_8441.html
 English: http://www.aeanet.org/governmentaffairs/gabl_HK_Art3_EIPTranslation.asp

People's Republic of China SJ/T 11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products http://www.aeanet.org/governmentaffairs/gajl_MCV_SJT11363_2006ENG.asp

People's Republic of China SJ/T 11364-2006 Marking for Control of Pollution Caused by Electronic Information Products. http://www.aeanet.org/governmentaffairs/gajl_LABELING_SJT11364_2006ENG.asp

Rhode Island Mercury Education and Reduction Act <http://www.rilin.state.ri.us/Statutes/TITLE23/23-24.9/INDEX.HTM>

Washington, State of, Title 70, Revised Code of Washington, Public Health and Safety. An Act relating to phasing out the use of polybrominated diphenyl ethers.
<http://www.leg.wa.gov/pub/billinfo/2007-08/Pdf/Bills/Session%20Law%202007/1024-S.SL.pdf>

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Appendix A. Revision History

Date	EC Level	Changes
2009-05-4	EC L36753	<p><u>Section 1.1.</u> - information added to show this revision includes the 2009 exemptions.</p> <p><u>Section 1.2</u> - Definition for “Not Detected” edited.</p> <p><u>Section 2.1</u> - Other RoHS jurisdictions added and clarification that not all are cited and may have differing scope and requirements.</p> <p><u>Table 1</u> - Reportable level for mercury edited.</p> <p><u>Table 2</u> - Added to clearly define new 2009 RoHS exemption status and sunset the use of exemptions 8a, 11a, 12, 14, 22 and 23 for IBM products and parts released after May 4, 2009.</p> <p><u>Section 2.2</u> -Table 2 added to show altered exemptions for 2009 changes. Exemptions 30, 31 and 32 added.</p> <p><u>Section 2.3.4</u> - Edit made to clarify that leaded solder exemption for servers and storage products will expire.</p> <p><u>Section 2.4.3</u> - Section detailing information about the modular refrigeration unit was deleted.</p> <p><u>Appendix B</u> - Added to show the 2009 exemptions changes as recommended by Öko-Institut.</p>
2007-11-26	EC L35908	<ul style="list-style-type: none"> •Section 1.1 - Paragraph added to clarify that most restrictive requirement applies. •Section 1.2 - Definitions added for Deliverable, Intentionally Added or Intentional Addition, Materials, Not Detected, Parts, and Products. The Deliverable replaced the words “material”, “part”, “product”, and “assembly” in multiple locations throughout the specification •Section 1.3 - Specification deviation process changed. •Table 1 - Additional material restrictions required by other laws than EU RoHS, which are more restrictive than EU RoHS are now referenced in Engineering Specification 46G3772. •Section 2.1 - Additional entries added to the list of jurisdictions with RoHS type requirements. Section 2.2.- The exemption numbers were aligned with the numbers in the EU RoHS Directive and amendments. Exemptions 10b was added. Listing of batteries in the exemption list removed and replaced with a paragraph describing the exemption for batteries. •Table 3 - Updated the RoHS-Compatible Surface Finish Materials for Printed Circuit Boards. •Section 2.6 - PBB Table updated with CAS numbers. •Section 3 - Additional references added.
2006-10-31	EC H86911	<ul style="list-style-type: none"> •Title - Expanded scope of regulations to additional jurisdictions. •Section 1.3 - Added text referring suppliers may use analytical techniques to confirm results with a reference to the document - IBM STG RoHS Analysis Guideline SG-D-0417 with web location. •Section 2.1 Expanded scope of regulations to other jurisdictions •Section 2.1 Table 1. Removed reference to an IBM STG RoHS Analysis Guideline. Further clarification for cadmium applications including an exemption for use of cadmium in electrical contacts. Allowable level for cadmium use in pigment, dye and stabilizer applications was raised to 100ppm due to a change in the Denmark Cadmium decree. The levels for PBBs and PBDEs were changed to reflect the requirements in 46G3772 of no intentional addition. •Section 2.2 - Additional exemptions were added. •Section 2.3 - Table 3 deleted and a reference made to IBM Procurement Specification 873444 for conditionally acceptable finishes. •Section 3.0 - Additional references cited.
2006-03-24	H87225	<ul style="list-style-type: none"> •Section 1.2: A sentence was added to the end of the first paragraph to clarify "homogenous". Added "Homogeneous is understood to be of uniform composition throughout." •Section 1.3: Information detailing that electrical and electronic tools are covered, but non electrical tools are not. Consumable items, such as ink cartridges, CDs, DVDs, floppy disks, tape cartridges, customer publications and product packaging are not included. Requirements for deviations from the specification were added. •Table 1: A separate line was added for cadmium in plating and the line for cadmium used in relays and circuit breakers was eliminated. Plating was removed from the 75 ppm category and put into a category where cadmium is not allowed in plating or surface coating. A footnote was added to clarify California Prop 65 requirements for frequently handled cables such as mice cables. No intentional addition of lead carbonates and lead sulfates in paints was added to the first footnote. This last requirement mirrors the requirement in 46G3772. In footnote 2 and 4, the supplier is referred to the procurement web site for an IBM document which references IBM

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recommended testing methodologies for mercury and cadmium. Footnote 5 now clarifies that hexavalent chromium is not allowed "in the manufacturing process."

- Section 2.2 - the RoHS exemption "Cadmium and its compounds in electrical contacts and cadmium plating....." was eliminated due to more stringent laws in Switzerland, The Netherlands and Austria.
- Section 2.3: Table 2 for acceptable finishes was broke out into two tables - one for "Acceptable materials for electronic components" and one table for "RoHS-Compatible Materials for Printed Circuit Boards." Table 3 has additional acceptable finishes for Tantalum Niobium and Niobium Oxide Capacitors, Actives, Crystal/Oscillators, Resistors/Resistor Networks and Magnetics.
- Section 2.3.4 - New "Acceptable uses of leaded solder" were added - 1. as a finish for termination based components, 2. solder/brazing of fins to heatsinks and 3. lead use in specific part numbers.
- Section 2.3.2: Section was rewritten, and Table 4 was created and added to the document.
- Section 2.4: The wording was updated and clarified. Hexavalent chromium is not to be used in finishing processes for sheet steel, etc.
- Section 2.6 - The number 209 was added as the number of congeners of PBBs and/or PBDEs.
- Section 3.0: Three new references were added - the three new EU Commission Decisions for maximum concentration values, and additional exemptions such as lead use in compliant pin connector systems.

Appendix B. Summary of 2009 RoHS Exemption Changes as Published by Öko-Institut Final Report February 20, 2009.

This table is provided for information only.

New No.	2009 Expiration Date	2009 Exemption Wording	Old No.	2006 - 2008 Exemption Wording
1		Mercury in single capped fluorescent lamps not exceeding (per burner):	1	Mercury in compact fluorescent lamps not exceeding 5 mg per lamp.
	July 31, 2014	For general lighting purposes < 50 Watts: 3.5 mg		
	July 31, 2014	For general lighting purposes ≥ 50 Watts and < 150 Watts: 5 mg		
	December 31, 2012	For general lighting purposes > 150 Watts: 15 mg		
	July 31, 2014	For general lighting purposes with circular or square structural shape and tube diameter ≤ 17 mm: 7 mg		
	July 31, 2014	For special purposes: 5 mg		
2a		Mercury in double-capped linear fluorescent lamps for general purposes not exceeding:	2	Mercury in straight fluorescent lamps for general purposes not exceeding: - halophosphate 10 mg, - triphosphate with normal lifetime 5 mg, - triphosphate with long lifetime 8 mg.
	July 31, 2014	Tri-band phosphor with normal lifetime T2: 4 mg		
	July 31, 2014	Tri-band phosphor with normal lifetime > T2 and ≤ T5: 3 mg,		
	July 31, 2014	Tri-band phosphor with normal lifetime > T5 and ≤ T8 and < 183cm: 3.5 mg,		
	July 31, 2014	Tri-band phosphor with normal lifetime > T8 and ≤ T12: 3.5 mg,		
	July 31, 2014	Tri-band phosphor with long lifetime: 5 mg.		
2b		Mercury in other fluorescent lamps not exceeding:		
	July 31, 2014	Halophosphates all shapes: 8 mg,		
	July 31, 2014	T5 non-linear tri-band phosphor lamps: 8 mg,		
	July 31, 2014	T9 non-linear tri-band phosphor lamps: 15 mg,		
	July 31, 2014	Induction lamps: 15 mg.		

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3		Mercury in cold cathode fluorescent lamps (CCFL):	3	Mercury in straight fluorescent lamps for special purposes.
	December 31, 2012	Mercury in short length (not over 500 mm) CCFLs and external electrode fluorescent lamps (EEFL) not exceeding 3.5 mg per lamp.		
	December 31, 2012	Mercury in medium length (over 500 mm and not over 1500 mm) CCFL and EEFL not exceeding 5 mg per lamp.		
	December 31, 2012	Mercury in long length (over 1500 mm) CCFL and EEFL not exceeding 13 mg per lamp.		
4a-I		Mercury in high pressure sodium (vapour) lamps for general lighting purposes not exceeding in lamps with improved colour rendering index > 60:	4	Mercury in other lamps not specifically mentioned in this Annex (Annex is found in the EU RoHS Directive.)
	July 31, 2014	P ≤ 155 W: 30 mg per burner,		
	July 31, 2014	155 < P ≤ 405 W: 40 mg per burner,		
	July 31, 2014	P > 405 W: 40 mg per burner.		
		Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding in other High Pressure Sodium (vapour) lamps:		
	July 31, 2014	P ≤ 155 W: 25 mg per burner,		
	July 31, 2014	155 < P ≤ 405 W : 30 mg per burner,		
	July 31, 2014	P > 405 W: 40 mg per burner.		
4a-II	July 31, 2014	Mercury in High Pressure Mercury (Vapour) lamps except for general lighting (HPMV).		
4a-II I	July 31, 2014	Mercury in Metal halide lamps (MH).		
4b	July 31, 2014	Mercury in other discharge lamps for special purpose not specifically mentioned in this Annex.		
5	July 31, 2014	Lead (Pb) in the glass of cathode ray tubes.	5	Lead (Pb) in the glass of cathode ray tubes, electronic components, and fluorescent tubes.
	July 31, 2014	Lead (Pb) in the glass of fluorescent tubes not exceeding 0.2% by weight.		
	July 31, 2014	Electrical and electronic components which contain lead (Pb) in a glass or ceramic other than a dielectric ceramic, or in a glass or ceramic matrix compound (e.g., piezoelectric devices) until 31 July 2014, and for the repair, and to the reuse, of equipment put on the market before 1 January 2015.		
6a	December 31, 2013	Lead (Pb) as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight.	6	Lead (Pb) as an alloying element in steel containing up to 0.35% lead by weight, aluminum containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.
6b	December 31, 2013	Lead (Pb) as an alloying element in aluminum containing up to 0.4% lead by weight.		
6c	December 31, 2013	Copper alloy containing up to 4% lead (Pb) by weight.		
7a	June 30, 2013	Lead (Pb) in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead) until 30 June 2013, and lead in such solders for the repair and reuse of equipment put on the market before 1 July 2013.	7a	Lead (Pb) in high melting temperature type solders (i.e. Lead-based alloys containing 85% by weight or more lead.)
7b	July 31, 2014	Lead (Pb) in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications until 31 July 2014, and	7b	Lead (Pb) in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications,

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		for the repair or the reuse of such equipment put on the market before 1 August 2014.		
7c	July 31, 2014	Electrical and electronic components which contain lead (Pb) in a glass or ceramic other than a dielectric ceramic, or in a glass or ceramic matrix compound (e.g. Piezoelectric devices) until 31 July 2014, and for the repair, and to the reuse, of equipment put on the market before 1 August 2014.	7c	Lead (Pb) in electronic ceramic parts (e.g. Piezoelectric devices.)
	July 31, 2014	Electrical and electronic components for a voltage of 125V AC or 250V DC or higher which contain lead (Pb) in a dielectric ceramic until 31 July 2014, and for the repair, and to the reuse, of equipment put on the market before 1 August 2014.		
	December 31, 2012	Electrical and electronic components for a voltage of less than 125V AC or 250V DC which contain lead (Pb) in a dielectric ceramic until 31 December 2012, and for the repair, and to the reuse, of equipment put on the market before 1 January 2013. .		
8	December 31, 2011	Cadmium and its compounds in one shot pellet type thermal cut-offs until 31 December 2011 and in one shot pellet type thermal cut-offs used as spare parts for the reuse and repair of equipment put on the market before 1 January 2012.	8	Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations.
	July 31, 2014	Cadmium and its compounds in electrical contacts until 31 July 2014, and in electrical contacts in spare parts used for the repair and reuse of equipment put on the market before 1 August 2014.		
9	December 31, 2013	Hexavalent chromium as an anticorrosion agent of the carbon steel cooling system in absorption refrigerators up to 0.75 weight- % in the cooling solution except for applications where the use of other cooling technologies is practicable (e.g., available on the market for the specific area of application) and does not lead to negative environmental, health and/or consumer safety impacts.	9	Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators.
9a	Expired June 30, 2008.		9a	DecaBDE in polymeric applications (expired June 30, 2008)
9b	July 31, 2014	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for HVACR (Heating, Ventilation, Air Conditioning and Refrigeration) applications.	9b	Lead (Pb) in lead-bronze bearing shells and bushes.
11a	June 30, 2010	Lead (Pb) used in C-press compliant pin connector systems until 30 June 2010, and for the repair, and to the reuse, of electrical and electronic equipment put on the market before 1 July 2010.	11	Lead (Pb) used in compliant pin connector systems.
11b	December 31, 2012	Lead (Pb) used in other than C-press compliant pin connector systems until 31 December 2012, and for the repair, or to the reuse, of electrical and electronic equipment put on the market before 1 January 2013.		
12	June 30, 2010	Lead (Pb) as a coating material for the thermal conduction module C-ring until 30 June 2010, and for the repair, or to the reuse, of electrical and electronic equipment put on the market before 1 July 2010.	12	Lead (Pb) as a coating material for thermal conduction module c-ring.
13a	July 31, 2014	Lead (Pb) in white glasses used for optical applications.	13	Lead (Pb) and cadmium in optical and filter glass.
13b	July 31, 2014	Cadmium and lead in filter glasses.		
14	December 31,	Lead (Pb) in solders consisting of more than	14	Lead (Pb) in solders consisting of more than two

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	2010	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 until 31 December 2010, and for the repair and reuse of products that were put on the market before 1 January 2011.		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.
15	July 31, 2014	Lead (Pb) in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages until 31 July 2014, and for the repair, or to the reuse, of electrical and electronic equipment put on the market before 1 August 2014.	15	Lead (Pb) in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages.
16	Not to be continued (transition period until mid 2011.)	Lead (Pb) in linear incandescent lamps with silicate coated tubes.	16	Lead (Pb) in linear incandescent lamps with silicate coated tubes.
17	July 31, 2014	Lead (Pb) halide as radiant agent in High Intensity Discharge (HID) lamps used for professional reprography applications.	17	Lead (Pb) halide as radiant agent in High Intensity Discharge (HID) lamps used for professional reprography applications.
18	July 31, 2014	Lead (Pb) 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)	18	Lead (Pb) 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) as well as when used as specialty lamps for diazo-printing reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ((Sr,Ba)2MgSi ₂ O ₇ :Pb).
19	Not to be continued (transition period until mid 2011.)	Lead (Pb) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PSn-Hg as auxiliary amalgam in very compact Energy Saving Lamps (ESL.)	19	Lead (Pb) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PSn-Hg as auxiliary amalgam in very compact Energy Saving Lamps (ESL.)
20	Not to be continued (transition period until mid 2011.)	Lead (Pb) oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCD.)	20	Lead (Pb) oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCD).
21	July 31, 2014	Lead (Pb) and Cadmium (Cd) in printing inks for the application of enamels on borosilicate glass.	21	Lead (Pb) and Cadmium (Cd) in printing inks for the application of enamels on borosilicate glass.
22	December 31, 2009	Lead (Pb) as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems.	22	Lead (Pb) as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems.
23	June 30, 2010	Lead (Pb) in finishes of fine pitch components other than connectors with a pitch of 0.65 mm and less until 30 June 2010, lead in the finishes of such fine pitch components used as spare parts for the repair and reuse of equipment put on the market before 1 July 2010.	23	Lead (Pb) in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead frames.
24	July 31, 2014	Lead (Pb) in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors until 31 July 2014, and for repair and reuse of equipment put on the market before 1 August 2014.	24	Lead (Pb) in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors.
25	July 31, 2014	Lead (Pb) oxide in surface conduction electron emitter displays (SED) used in structural elements; notably in the seal frit and frit ring.	25	Lead (Pb) oxide in plasma display panels (PDP) and surface conduction electron emitter displays (SED) used in structural elements; notably in the front and rear glass dielectric layer, the bus electrode, the black stripe, the address electrode, the barrier ribs, the seal frit and frit ring as well as in print pastes.
26	Not to be continued (transition period until mid 2011.)	Lead (Pb) oxide in the glass envelope of Black Light Blue (BLB) lamps	26	Lead (Pb) oxide in the glass envelope of Black Light Blue (BLB) lamps

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27	Not to be continued (transition period until mid 2011.)	Lead (Pb) 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.	27	Lead (Pb) 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.)
28	Not to be continued (already expired.)	Exemption expired July 1, 2007.	28	Hexavalent chromium in corrosion preventive coatings of unpainted metal sheetings and fasteners used for corrosion protection and Electromagnetic Interference Shielding in equipment falling under category three of Directive 2002/96/EC (IT and telecommunications equipment.)
29	July 31, 2014	Lead (Pb) bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC.	29	Lead (Pb) bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC.
30	No expiry date at this time.	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.	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.
31	No expiry date at this time.	Lead (Pb) in soldering materials in mercury free flat fluorescent lamps (which e.g. Are used for liquid crystal displays, design or industrial lighting.)	31	Lead (Pb) in soldering materials in mercury free flat fluorescent lamps (which e.g. Are used for liquid crystal displays, design or industrial lighting.)
32	No expiry date at this time.	Lead (Pb) oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes.	32	Lead (Pb) oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes.

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