



# About this guidance

**This guide is addressed to all businesses and individuals placing electrical and electronic equipment on the UK market.**

**It clearly explains the requirements of the legislation, including a decision tree and flow chart.**

**This guidance cannot cover every situation and, of course, it may be necessary to carefully consider the relevant legislation to see how it applies in your circumstances. However, if you do follow the guidance it will help you to understand how to comply with the law.**

**This guidance has been designed to comply with the “Code of Practice on Guidance on Regulation 2009”. This was published in October 2009 and a copy can be downloaded from the BIS website at [www.bis.gov.uk](http://www.bis.gov.uk).**

**This is the February 2011 edition and replaces all earlier editions. The guidance is updated on a regular basis as necessary.**

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# RoHS – the law in brief

## Summary

1. The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2008<sup>1</sup>, as amended, (“the RoHS Regulations”) implemented the provisions of the European Parliament and Council Directive on the Restrictions of the use of certain Hazardous Substances in electrical and electronic equipment<sup>2</sup> (“the RoHS Directive”), as amended.
2. The RoHS Regulations have banned the putting on the UK market of new Electrical and Electronic Equipment (EEE) containing more than the permitted levels of lead, cadmium, mercury, hexavalent chromium and both polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants since 1 July 2006. There are a number of exempted applications for these substances.
3. Since 1 July 2006, manufacturers have needed to ensure that their products - and the components and subassemblies of such products - comply with the requirements of the Regulations by the relevant date in order to be put on the Single Market. The Regulations have also had an impact on those who import EEE into the European Union on a professional basis, those who export to other Member States and those who rebrand other manufacturers’ EEE as their own.
4. The RoHS Regulations do not affect the application of existing legal requirements for EEE, including those regarding safety, the protection of health, existing transport requirements or provisions on hazardous waste. In other words, existing legislation on EEE and hazardous substances must also be complied with.

## Entry into force

5. The RoHS Regulations came into force on **1 February 2008**, but replace similar Regulations<sup>3</sup> that came into force on 1 July 2006.

## Requirements

6. The main requirement of the RoHS Regulations is that from 1 July 2006 a producer (as defined in the Regulations) may not put new EEE containing lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE), in amounts exceeding the established maximum concentration values, on the market. Certain applications (listed in Annex C and referred to in Regulation 5) are exempt and there is also an exemption for spare parts for the repair of equipment that had been put on the market before 1 July 2006. The RoHS Regulations also do not apply to the re-use of equipment that was put on the market before the same date.
7. Producers must be able to demonstrate compliance by submitting technical documentation or other information to the enforcement authority on request and

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<sup>1</sup> SI 2008 No. 37, as amended by the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (Amendment) Regulations 2009 (SI 2009 No. 581).

<sup>2</sup> Directive 2002/95/EC of 27 January 2003, (OJ No. L37, 13.2.2003, p. 19).

<sup>3</sup> The RoHS Regulations 2006, (SI 2006 No. 1463).

must retain such documentation for a period of four years after the EEE is placed on the market.

### Enforcement

8. Responsibility for the enforcement of the RoHS Regulations lies with the Secretary of State for Business, Innovation & Skills, who has appointed the National Measurement Office (NMO), an executive agency of the Department, to act on his behalf.

## RoHS Regulations

### Scope

9. The RoHS Regulations apply to all EEE containing hazardous substances put on the market in the UK on or after 1 July 2006, which falls into any of the eight broad categories listed in Annex A. Annex A also includes indicative (but not exhaustive) examples of products under each of the categories. The RoHS Regulations specify a voltage range within which the products in the eight categories must fall in order to come within the scope. This is up to and including 1,000 volts AC or up to and including 1,500 volts DC.
10. The eight broad categories mentioned above reflect eight of the ten categories in Annex 1 of the Waste Electrical and Electronic Equipment (WEEE) Directive<sup>4</sup>. In addition, the RoHS Regulations apply both to electric light bulbs and to household luminaires.
11. The two categories of the WEEE Directive **not** included within the scope of the RoHS Regulations are Medical Devices and Monitoring & Control Instruments. Please note, however, that Article 6 of the RoHS Directive places an obligation on the European Commission to present proposals for including EEE falling within those two categories within the scope of the RoHS Directive, once scientific and technical evidence has demonstrated that such proposals are feasible. In this respect, the Commission asked independent consultants to undertake a study to review the current position. The results of that study were published by the Commission in July 2006 and informed the agreement of a new RoHS Directive in 2010.

### Assessing products to see if they are included in the scope

12. For many products, the decision on whether they are included within the scope of these Regulations should be reasonably straightforward. However there are a number of products (particularly in specialised or industrial sectors), where there may be significant areas of doubt and uncertainty.
13. An example of a 'decision tree' that could be used by producers to help determine whether their products might come within the scope of the RoHS Regulations can be found at Annex B.

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<sup>4</sup> Directive 2002/96/EC of 27 January 2003, (OJ No. L37, 13.2.2003, p. 24).

14. The guidance that follows uses some of the criteria for assessing “grey area” products (those whose inclusion within the scope of the RoHS Directive is in doubt) that have been discussed in the Technical Adaptation Committee (TAC) of Member States and reflects the Commission’s Frequently Asked Questions document on the WEEE and RoHS Directives<sup>5</sup>.

i. *EEE intended to protect national security and/or for military purposes*

On the basis that there is an express exemption from the categories of Annex 1A of the WEEE Directive in relation to EEE intended specifically to protect national security and/or for military purposes, it is the view of BIS and the Commission that equipment connected with the protection of the essential security interests of Member States and to arms, munitions and war material may, accordingly, be considered to be exempt from the provisions of the RoHS Directive. It should be noted, however, that this exemption would not apply to any equipment that is used to protect national security and/or has a military purpose, but is not designed exclusively for these purposes.

ii. *Products where electricity is not the main power source*

Many products contain electrical and electronic components, either for additional functionality or as peripheral parts. A simple example could be a combustion engine with an electronic ignition. The definition of EEE in the Regulations extends only to those products that are dependent on electric currents or electromagnetic fields to work properly, meaning that it is the primary power source. When the electric current is switched off, the product cannot fulfil its main function. If electricity is used only for control or support functions, the product could be considered to be outside the scope of the RoHS Regulations. In the above example the combustion engine would be considered to be outside that scope.

One exception to this general rule is sports equipment with electric or electronic components, which is a specific item listed within Annex A of this Guidance as it is drawn directly from the indicative list in Annex 1A of the WEEE Directive. In this case, all sports equipment with electric or electronic components are considered to come within the scope of the RoHS Regulations regardless of whether or not those components are required for the primary function of the equipment.

iii. *Products where the electrical or electronic components are not needed to fulfil the primary function*

This is related to, but not always the same as the above situation. Some

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<sup>5</sup> European Commission’s *Frequently Asked Questions on the RoHS and WEEE Directives* published May 2005 and revised August 2006. This can be downloaded from [http://ec.europa.eu/environment/waste/weee/index\\_en.htm](http://ec.europa.eu/environment/waste/weee/index_en.htm)

products, particularly toys and novelty items contain an electrical or electronic element that gives added value to the product. Often there are similar products on the market fulfilling the same function, but without these components. Examples might include musical greetings cards or soft toys with electronic components, which still fulfil their primary function without their electronic components and could be considered to be outside the scope of the RoHS Regulations.

iv. *Electrical and electronic equipment that is part of another type of equipment*

The WEEE Directive excludes EEE that is part of another type of equipment that does not fall within the scope of the Directive. On the basis that EEE under the RoHS Directive is defined in identical terms, it is the view of BIS and the Commission's Legal Services that such an exclusion extends to EEE under the RoHS Directive and, consequently, to the RoHS Regulations. Examples of such equipment would be lighting or entertainment equipment for use in vehicles, trains or aircraft. This type of equipment would be excluded as it is designed to be part of a product that falls outside the scope of the Directive.

Equipment that is part of another type of equipment or system is considered to be outside the scope of the Directive where it does not have a direct function outside the other item of equipment or system and that other item of equipment or system is itself outside the scope of the Directive.

Equipment may also be part of a fixed installation. A "fixed installation" may be a combination of several pieces of equipment, systems, products and/or components (or parts) assembled and/or erected by a professional assembler or installer at a given place to operate together in an expected environment and to perform a specific task, but not intended to be placed on the market as a single functional or commercial unit.

In such a case, the elements of a system that are not discernible EEE products in their own right or that do not have a direct function away from the installation are excluded from the scope of the RoHS Regulations.

v. *Batteries*

The RoHS Directive restricts the use of the named hazardous substances in new electrical and electronic equipment, but in the view of the European Commission does not apply to batteries. This includes batteries that are permanently fixed into the product, as well as removable batteries. Under the treatment requirements of the WEEE Regulations<sup>6</sup>, batteries must be removed from any separately collected waste electrical and electronic equipment. A European Commission Directive, adopted in September 2006, introduced further requirements on battery and electrical equipment manufacturers. The Batteries and Accumulators & Waste Batteries and

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<sup>6</sup> The Waste Electrical and Electronic Equipment Regulations 2006 as amended, (SI 2006 No. 3289).

Accumulators Directive<sup>7</sup> restricts the use of certain materials in most types of batteries put on the market and also includes provisions requiring their easy removal from equipment. This Directive also introduces treatment and recycling obligations, alongside collection targets.

The UK has implemented this Directive through two sets of Regulations. The Batteries and Accumulators (Placing on the Market) Regulations 2008<sup>8</sup> implements the technical requirements for new batteries and equipment containing them and the Waste Batteries and Accumulators Regulations 2009<sup>9</sup> implements the requirements for the collection and treatment of waste batteries.

## Exemptions

15. The RoHS Regulations do not apply:

- To large-scale stationary industrial tools. (This is a machine or system, consisting of a combination of equipment, systems, products and/or components installed by professionals, each of which is designed, manufactured and intended to be used only in fixed industrial applications.)
- To spare parts for the repair of EEE that was placed on the market before 1 July 2006. It should be noted that, following discussions in the TAC, the European Commission and Member States have agreed that this exemption extends to parts that expand the capacity of and/or upgrade EEE placed on the market before that date provided the EEE concerned is not put on the market as a new product.
- To the reuse of EEE that was placed on the EU market before 1 July 2006.
- To the specific applications of lead, mercury, cadmium, hexavalent chromium and PBDE set out in the Annex to the RoHS Directive, as amended by Commission Decision 2010/571/EC<sup>10</sup> and associated Corrigendum<sup>11</sup>. These specific applications are explained in more detail in Annex C of these Guidance Notes.

## Possible future exemptions

16. Since the RoHS Directive was published in February 2003, the European Commission has received many requests from industry for exemptions of additional specific applications of the hazardous substances. These requests extend the list in the original Annex to the RoHS Directive, once they have been agreed and adopted as Commission Decisions.

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<sup>7</sup> Directive 2006/66/EC of 6 September 2006, (OJ No. L266, 26.9.2006, p.1).

<sup>8</sup> SI 2008/2164.

<sup>9</sup> SI 2009/890.

<sup>10</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0028:0034:EN:PDF>

<sup>11</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:254:0048:0048:EN:PDF>



17. The Commission has already reviewed many of the requests and, as a consequence, has published the nine separate Commission Decisions that are listed in footnote 10.
18. The RoHS Regulations incorporate both those exemptions which have already been adopted and any further exemptions which may be agreed<sup>12</sup> while they remain in force, as the Department has taken advantage of new provisions so as to refer to the exempt applications listed in the RoHS Directive Annex “as amended from time to time”. While this has removed the need for further amendments to the RoHS Regulations each and every time new exemptions are agreed, Annex C of these Guidance Notes will be amended and reissued whenever a new exemption is agreed.

## Definitions

19. The definitions of “**electrical and electronic equipment**” and “**hazardous substances**” can be found within the RoHS Regulations.
20. The definition of “**producer**” can also be found within the RoHS Regulations, but it should be noted that whoever exclusively provides financing under or pursuant to any finance agreement shall not be deemed to be a producer unless he also acts as a producer within the meaning of sub points (i) to (iii) of that definition.
21. “**Put on the market**” is not defined in the RoHS Regulations or in the Directive, but it is being interpreted in the same way as the term ‘placing on the market’, which is defined in the European Commission’s “*Guide to the implementation of directives based on the New Approach and the Global Approach*”<sup>13</sup> (commonly referred to as the “Blue Book”). This says that ‘placing on the market’ is the initial action of making a product available for the first time on the Community market, with a view to distribution or use in the Community.
22. A product is placed on the Community market when it is made available for the first time. This is considered to take place when a product is transferred from the stage of manufacture with the intention of distribution or use on the Community market. Thus, imports for own use are also considered as being placed on the market at the moment they enter the Community. Moreover, the concept of placing on the market refers to each individual product, not to a type of product, and whether it was manufactured as an individual unit or in a series.
23. The transfer of the product takes place either from the manufacturer, or the manufacturer’s authorised representative in the Community, to the importer established in the Community or to the person responsible for distributing the product on the Community market. The distribution chain can also be the commercial chain of the manufacturer or the authorised representative. The transfer may also take place directly from the manufacturer, or authorized representative in the Community, to the final consumer or user.

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<sup>12</sup> Adopted and published as Commission Decisions in the EC Official Journal.

<sup>13</sup> The *Guide to the implementation of directives based on the New Approach and the Global Approach* can be downloaded from <http://ec.europa.eu/enterprise/newapproach/legislation/guide/index.htm>

24. The product is considered to be transferred either when the physical hand-over or the transfer of ownership has taken place. This transfer can be for payment or free of charge, and it can be based on any type of legal instrument. Thus, a transfer of a product is considered to have taken place, for instance, in the circumstances of sale, loan, hire, leasing and gift.

### Maximum concentration values

25. For the purposes of the RoHS Regulations, a maximum concentration value of up to 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, PBB and PBDE and of up to 0.01% by weight in homogenous materials for cadmium will be permitted in the manufacture of new EEE. These values were established through the adoption of a Commission Decision on 18 August 2005<sup>14</sup>.

26. “**Homogeneous material**” means a material that cannot be mechanically disjointed into different material.

27. The term “**homogeneous**” is understood as "of uniform composition throughout", so examples of "homogeneous materials" would be individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins and coatings.

28. The term “**mechanically disjointed**” means that the materials can, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

29. Using these interpretations, a plastic cover (for example) would be a ‘homogeneous material’ if it consisted exclusively of one type of plastic that was not coated with or had attached to it (or inside it) any other kinds of materials. In this case, the maximum concentration values of the RoHS Regulations would apply to the plastic.

30. On the other hand, an electric cable that consisted of metal wires surrounded by non-metallic insulation materials would be an example of something that is not ‘homogeneous material’ because mechanical processes could separate the different materials. In this case the maximum concentration values of the RoHS Regulations would apply to each of the separated materials individually.

31. A semi-conductor package (as a final example) would contain many homogeneous materials, which include the plastic moulding material, the tin-electroplating coatings on the lead frame, the lead frame alloy and the gold-bonding wires.

### Compliance

32. Producers must demonstrate compliance with the RoHS Regulations by providing the enforcement authority (on request) with satisfactory evidence of such compliance in the form of relevant technical documentation or information. The

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<sup>14</sup> Commission Decision 2005/618/EC of 18 August 2005, (OJ No. L214, 19.08.2005, p.65).

UK has adopted self-declaration as the basis of the compliance regime. The enforcement authority is undertaking market surveillance activities to detect non-compliant products and is also conducting tests for this purpose.

33. There is no prescribed method to demonstrate compliance or marking requirements. There are also no registration obligations, but producers may wish to consider the role that both materials declarations and component or material analysis could play.

### ***Materials declarations***

34. Producers of EEE could obtain an assurance from their suppliers that any materials, components, assemblies or equipment provided do not contain more than the permitted level of any of the six restricted substances, except where the application of any of those substances comes within the scope of the RoHS Regulations' exempted applications. Producers are required to keep appropriate records for a period of up to four years after the particular EEE product was put on the market.
35. A variety of materials declarations for suppliers are being developed by industry at the moment. Some finished or end product manufacturers have already started to publish such data on their websites.

### ***Producer analysis***

36. Producers of EEE to be placed on the UK market may wish to undertake (or ask a third party to undertake) their own analysis of the components or materials that they use in their products. This action may be undertaken either to verify supplier declarations or to establish the presence or otherwise of the restricted substances in those cases where no declaration is available. It may also be undertaken if there are doubts over the reliability of declarations.
37. Producers or third parties may employ any suitable analytical technique in order to establish that their products comply with the maximum concentration values of the six restricted substances. The criteria for analysis will depend on the quantity of product put onto the market (less for small producers than for large producers), the relationship with suppliers, the risk of a banned substance being present, and the potential impact of that substance on the environment. Producers must ensure that they understand and take into account any limitations of the analytical technique they use.
38. At Annex D, you will find an example of a flow chart that has been designed to clarify the compliance process and could help producers determine when analysis of components might be advisable.

### **Enforcement**

39. It is the duty of the National Measurement Office, acting on behalf of the Secretary of State for Business, Innovation & Skills, to enforce these Regulations.
40. Various powers of enforcement are available, including:

- Making test purchases.
- Requiring the production of compliance documentation and other information which may provide evidence as to whether or not the Regulations have been complied with in a particular case or class of cases.
- Inspecting processes and performing analytical tests.
- Issuing a compliance notice requiring certain action to be taken.
- Issuing an enforcement notice requiring non-compliant goods to be withdrawn from the market or prohibiting or restricting the placing of non-compliant goods on the market.

### Offences and penalties

41. The RoHS Regulations introduced the following offences:

- i. Contravening or failing to comply with the prohibition on hazardous substances in the RoHS Regulations, or with an enforcement notice, could result in those held responsible facing a fine up to the statutory maximum (currently £5,000) on summary conviction or an unlimited fine on conviction on indictment.
- ii. Those failing to submit compliance documentation at the request of the enforcement authority may be liable on summary conviction to a fine up to level five on the standard scale (currently £5,000).
- iii. Procedural offences (obstruction of an enforcement officer, providing false or misleading information to the enforcement authority) are also punishable on summary conviction by a fine up to level five on the standard scale.

42. As an alternative, or in addition, to any of the above penalties, the court may, in certain circumstances, make an order requiring a person convicted of the offences referred to in paragraph 42 (i) and (ii) above to remedy the matters which have given rise to the commission of the offence. In addition, the court may order a person convicted of the offences referred to in paragraph 42 (i) above to reimburse the enforcement authority's costs of investigating the offence.

43. The defence of 'due diligence' is available where a person can show he took all reasonable steps and exercised all due diligence to avoid committing an offence. This may include reference to an act or default of, or reliance on information given by, a third party, in which case it must be accompanied by such information identifying the third party, as is information in the possession of the defendant.

44. The RoHS Regulations also provide for the 'liability of persons other than the principle offender', including a provision that where a company or other body corporate commits an offence, those concerned in its management and responsible (consciously or by negligence) for the commission of the offence, may also be prosecuted.

## Contact points for further information

### **Department for Business, Innovation & Skills**

Eco-design and Product Regulation Unit  
Environmental & Technical Regulation Directorate  
1 Victoria Street  
London SW1H 0ET  
Tel: +44 (0) 20 7215 5000  
Email: [env.regs@bis.gsi.gov.uk](mailto:env.regs@bis.gsi.gov.uk)  
Website: <http://www.bis.gov.uk/policies/business-sectors/environmental-and-product-regulations/environmental-regulations/restrictions-on-hazardous-substances-in-electrical-equipment>

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### **The National Measurement Office's (NMO) RoHS Enforcement Team**

A Government service working with electrical and electronic equipment manufacturers to deliver compliance with the RoHS Directive in the UK

RoHS Enforcement Team  
NMO  
Stanton Avenue  
Teddington  
TW11 0JZ  
Tel: +44 (0) 20 8943 7227  
Email: [rohs@nmo.gov.uk](mailto:rohs@nmo.gov.uk)  
Website: [www.rohs.gov.uk](http://www.rohs.gov.uk)

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### **Envirowise Telephone Helpline**

This Helpline is a telephone enquiry service, funded by the Government, providing a comprehensive information and signposting service for firms seeking advice on a wide range of environmental issues that may affect their business.

0800 585 794 (UK calls only)  
Website: [www.envirowise.gov.uk](http://www.envirowise.gov.uk)

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### **Business Link**

The Business Link website provides broad advice on compliance. Website: <http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1082900812&type=RESOURCES>

## **Annex A**

Categories of electrical and electronic equipment covered by the RoHS Regulations

### **1. Large household appliances**

(Such as large cooling appliances; refrigerators; freezers; other large appliances used for refrigeration, conservation and storage of food; washing machines; clothes dryers; dish washing machines; cooking; electric stoves; electric hot plates; microwaves; other large appliances used for cooking and other processing of food; electric heating appliances; electric radiators; other large appliances for heating rooms, beds, seating furniture; electric fans; air conditioner appliances; other fanning, exhaust ventilation and conditioning equipment)

### **2. Small household appliances**

(Such as vacuum cleaners; carpet sweepers; other appliances for cleaning; appliances used for sewing, knitting, weaving and other processing for textiles; irons and other appliances for ironing, mangling and other care of clothing; toasters; fryers; grinders, coffee machines and equipment for opening or sealing of containers or packages; electric knives; appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances; clocks, watches and equipment for the purpose of measuring, indicating or registering time; scales)

### **3. IT and telecommunications equipment**

(Such as centralised data processing; mainframes; minicomputers; printer units; personal computing; personal computers, including the CPU, mouse and keyboard; laptop computers, including the CPU, mouse and keyboard; notebook computers; notepad computers; printers; copying equipment; electrical and electronic typewriters; pocket and desk calculators; other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means; user terminals and systems; facsimile; telex; telephones; pay telephones; cordless telephones; cellular telephones; answering systems; other products or equipment of transmitting sound, images or other information by telecommunications)

### **4. Consumer equipment**

(Such as radio sets; television sets; video cameras; video recorders; hi-fi recorders; audio amplifiers; musical instruments; other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications)

**5. Lighting equipment, (including electric light bulbs and household luminaires)**

(Such as luminaires for fluorescent lamps; straight fluorescent lamps; compact fluorescent lamps; high intensity discharge lamps, including pressure sodium lamps and metal halide lamps; low pressure sodium lamps; other lighting equipment for the purpose of spreading or controlling light)

**6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)**

(Such as drills; saws; sewing machines; equipment for turning, milling, sanding, grinding, sawing; cutting; shearing; drilling; making holes; punching; folding; bending or similar processing of wood, metal and other materials; tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses; tools for welding, soldering or similar use; equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means; tools for mowing or other gardening activities)

**9. Toys, leisure and sports equipment**

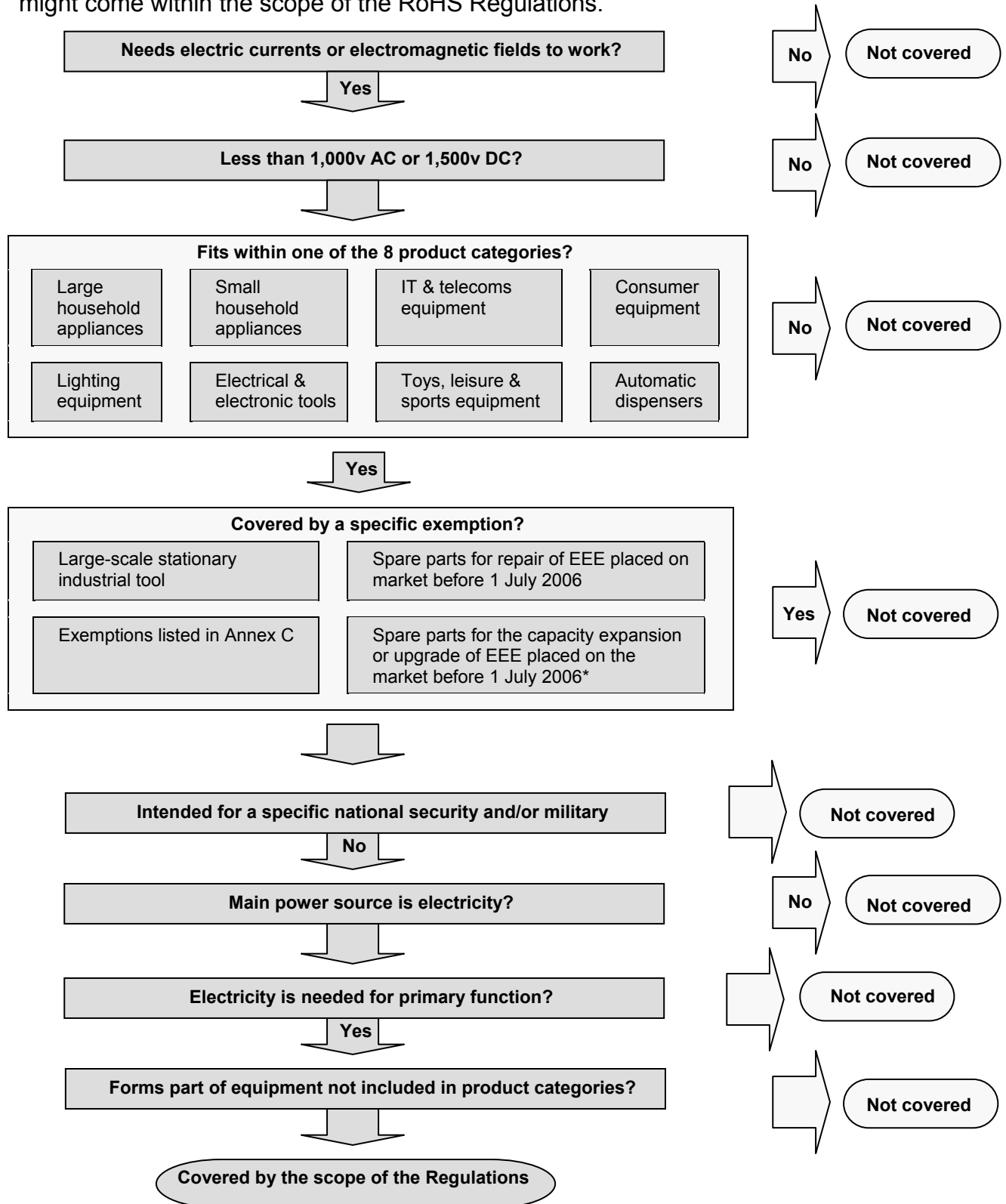
(Such as electric trains or car racing sets; hand-held video game consoles; video games; computers for biking, diving, running, rowing, etc.; sports equipment with electric or electronic components; coin slot machines)

**10. Automatic dispensers**

(Such as automatic dispensers for hot drinks; automatic dispensers for hot or cold bottles or cans; automatic dispensers for solid products; automatic dispensers for money; all appliances which deliver automatically all kind of products)

## Annex B

A 'decision tree' that could be used by producers to decide whether or not a product might come within the scope of the RoHS Regulations.



\*While these exclusions are not expressly provided for in the Directive, it is the view of BIS that they apply. It should be noted, however, that a definitive legal interpretation is only available from the court. Producers should rely on independent legal advice on compliance.



## Annex C

The information notes here should be read in conjunction with the official EC text which provides more details on the technical specifications.

### **1. Mercury in single capped (compact) fluorescent lamps not exceeding (per burner)**

A compact fluorescent lamp (CFL) is usually defined as a single-ended fluorescent lamp with a bent discharge tube of small diameter, of around 10-16 mm, to form a very compact unit. These lamps can be either integral, whereby the lamp and ballast are combined (also known as self-ballasted or self-supporting), or pin-based.

CFLs can contain no more than 5 mg of mercury per lamp. Mercury is needed in single capped fluorescence lamps to generate UV light that is converted to visible light by a fluorescent coating. Single capped compact fluorescent lamps are designed to be used in fittings suitable for incandescent lamps and the lamps contain the control circuit and lamp starter as well as a coiled fluorescent tube. The wattage of the lamp is proportional to the size of this tube and so its light output with more mercury being needed in higher wattage lamps. Lamps for general purpose lighting have different mercury limits depending on their wattage but special purpose lamps are different in design to those covered by exemptions 1a to 1e.

#### **1e. For general lighting purposes with circular or square structural shape and tube diameter $\leq 17$ mm**

Unlike standard compact fluorescent lamps, the tube is round or square with both ends inserted into a single socket fitting that contains the control circuit and the starter.

#### **2a/b. Mercury in straight fluorescent lamps for general purposes**

Double capped fluorescent lamps contain electrodes at each end of a glass tube that contains low pressure gas and mercury. When power is connected, a discharge occurs through the gas in the tube. The mercury vapour emits ultraviolet light that is converted to visible light by the fluorescent coating. The colour properties of straight fluorescent lamps are determined by the phosphors used to coat the inside of the tube. Halophosphate and tri-band phosphor are examples of such fluorescent materials.

Starter electronics are external to these types of lamp. This exemption is divided into subparts for different classifications of lamp. Mercury is permitted in the each type of lamps up to specific maximum amounts that depends on the lamp diameter. These maximum quantities reduce after specified dates for some types.

A summary table follows:

Lamp type	Maximum mercury content	Reduced mercury content
Tri-band phosphor normal lifetime diameter <9mm	5mg until 31 December 2011	4mg after 31 December 2011
Tri-band phosphor normal lifetime diameter 9 to 17mm	5mg until 31 December 2011	3mg after 31 December 2011
Tri-band phosphor normal lifetime diameter 17 to 28mm	5mg until 31 December 2011	3.5mg after 31 December 2011
Tri-band phosphor normal lifetime diameter >28mm	5mg until 31 December 2012	3.5mg after 31 December 2012
Triband phosphor with long life ( $\geq 25,000$ hours)	8mg until 31 December 2011	5mg from 31 December 2011
Linear halophosphate diameter >28 mm only	10mg until 13 April 2012	No exemption after 13 April 2012
Non-linear halophosphate	15mg until 13 April 2016	No exemption after 13 April 2016
Double capped linear fluorescent lamps for other general lighting and special purposes.	No mercury limit until 31 December 2011	15mg after 31 December 2011

### **3. Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp)**

Cold cathode fluorescent lamps (CCFL) and external electrode fluorescent lamps (EEFL) are used as backlights in displays (e.g. laptop PCs and flat-screen TVs) as well as in scanners and printers. The minimum amount of mercury needed depends on the lamp's length and so after 31 December 2011 the maximum mercury content is limited by this exemption.

Examples of such lamps are LCD back light lamps, disinfection lamps, medical/therapy lamps, pet care lamps (e.g. aquaria lamps), lamps with special components (e.g. integrated reflectors or external protection sleeves), lamps with special ignition features (e.g. designed for low temperatures), long length lamps (length > 1800mm) and amalgam lamps.

In this context, there is no restriction on the quantity of mercury in these lamps.

#### **4a. Mercury in other low pressure discharge lamps (per lamp)**

Examples of other lamps containing mercury are high intensity discharge (HID) lamps (e.g. sodium lamps and metal halide lamps), circular fluorescent lamps and U-shaped fluorescent lamps.

In this context, there is no restriction on the quantity of mercury in these lamps.

Exemption 4 and its sub-parts covers other types of discharge lamp that are not covered by exemptions 1 - 3.

**4b. Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index Ra > 60:**

High pressure sodium lamps with colour rendering index (CRI) Ra >60 containing both sodium metal and mercury are energy efficient pale white colour lamps (although CRI is not necessarily an indication of colour). The quantity of mercury required depends on the energy consumption / light output and so mercury limits are based on lamp energy ratings.

**4c. Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner)**

High pressure sodium lamps with CRI < 60 (e.g. used for yellow street lighting) contain both sodium metal and mercury. The quantity of mercury required depends on the energy consumption / light output and so mercury limits are based on lamp energy ratings.

**4d. Mercury in High Pressure Mercury (vapour) lamps (HPMV)**

High pressure mercury lamps contain large amounts of mercury but can be replaced in lighting applications by high pressure sodium and other types of lamp and this change will occur as a result of the eco-design tertiary lighting regulation. Substitution is not so straightforward for non-lighting uses such as in semiconductor manufacture.

**4e. Mercury in metal halide lamps (MH)**

Metal halide lamps, a type of discharge lamp that contain quantities of mercury specific to the design of lamp. As it is not possible to use more than this amount, no upper limit is necessary. Energy efficient design with lower mercury content have been developed but the Eco-design Directive is being used to regulate the change to more efficient designs of lamp

**4f. Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex**

This Sub-exemption allows the use of mercury in lamps that are not covered by lamp-specific exemptions. This includes a wide variety of specialist lamps sold in relatively small numbers which, due to their small environmental impact, have not been given lamp-type specific exemptions with limits on mercury content.

**5a. Lead in glass of cathode ray tubes, electronic components and fluorescent tubes**

Lead, or more specifically lead oxide, is often used in glass obtain specific characteristics, such as radiation protection in CRTs. ). This exemption has been

introduced because viable alternatives for these applications have not yet been identified.

For clarity, the exemption applies to lead as a constituent in the glass used in cathode ray tubes.

#### **5b. Lead in glass of fluorescent tubes not exceeding 0.2% by weight**

Lead is added to the glass of fluorescent tubes to provide strength and workability at its softening temperature. New fluorescent tubes do not require lead but as glass scrap is recycled for use in new lamps and contains lead, this exemption allows the use of scrap lead-containing glass to be used.

#### **6. Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminium containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight**

Lead is often used as an alloying element to obtain specific properties of a metal alloy. This exemption applies to the use of lead in steel up to 0.35% by weight, in aluminium up to 0.4% by weight and in copper alloys up to 4% by weight. In the context of this exemption, 'percentage by weight' has to be interpreted as 'the percentage of lead per homogeneous material per discrete part'. For example, if the steel housing of a computer consists of two separate parts, each part can contain up to 0.35% lead by weight of that part.

#### **7a. Lead in high melting temperature type solders (i.e. lead based alloys containing 85% by weight or more lead)**

For the purposes of applications 7, 8 and 9 in this Annex, 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.

The high melting temperature type solder exemption has been introduced to allow the use of lead in solders for specific applications (such as in power semiconductor package manufacturing), for which viable lead-free alternatives have not yet been identified. This exemption is permitted as there are no alternative alloys with similar melting point and which are ductile. The high electrical conductivity and unique mechanical properties of such a high melting point tin-lead alloy make the material malleable and better able to withstand both temperature and physical stress. Such properties ensure fewer defects during manufacturing and high reliability throughout the life of the component, thereby also resulting in fewer components going into the waste stream.

**7b. Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunication.**

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

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

Allows lead based solders to be used in IT and telecommunications network infrastructure equipment. This exemption does not cover end-terminating products such as PCs or telephones

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).

It is the view of BIS that this exemption is viewed as applying to lead in the solder of 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 lead in the solder of the components that are integrated into the whole computer or that are sold separately for use in an exempt server. The lead in the solder of cable assemblies, and all connectors and connector assemblies used to provide interconnections for the server, would also be covered by this exemption.

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.

It is the view of BIS that this exemption is viewed as applying to the whole of the device or subsystem and their 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 storage or storage array system or that are sold separately for use in an exempt storage or storage array system. Cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for the storage or storage array system, would also be covered by this exemption.

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.

For the purpose of the RoHS Regulations, **'network infrastructure equipment for telecommunication purposes'** is viewed by BIS as equipment meeting one of the two following criteria:

1) Any system used for routing, switching, signalling, transmission, or network management or network security; or

2) Any system which can simultaneously enable more than one end user terminating equipment to connect to a network.

It is also any such system in a network, except for end user terminating equipment such as voice terminals and facsimile machines.

This would include all servers, power supplies, 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 but is not intended to include desktop or notebook computers, telephones, fax machines or consumer – type modems or switches etc.

### **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**

Electronic components such as diodes, chip resistors, piezoelectric devices, etc. are permitted to contain glass or ceramic materials that contain lead

Ceramic materials are used in a variety of electronic devices including capacitors, insulators, piezoelectrics, magnets and integrated circuit packages. Some of these ceramic materials contain lead, for example lead zirconate titanate and lead magnesium niobate. The specific chemical composition and manufacturing process of these materials determine their electrical parameters, such as dielectric constant and the dissipation that is essential for the functioning of the component in which they are used. Hence, lead used in the ceramic parts of electronic components in electrical and electronic equipment is exempt from these Regulations.

### **7c-II. Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher**

The dielectric ceramic of some types of chip capacitor that are rated for voltages of 125V AC or 250 VDC or greater contain lead.

### **7c-III. Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC**

The dielectric ceramic of some types of chip capacitor that are rated for voltages of less than 125V AC or 250 VDC contained lead in the past but lead-free substitutes have been developed and so this exemption expires in 2013.

### **8a. Cadmium and its compounds in one shot pellet type thermal cut-offs**

Exemption 8 for cadmium in electrical contacts has been split into two so that where these are used in on-shot thermal cut-offs this exemption expires on 1 January 2012. One-shot thermal cut-offs are a type of fuse that opens when it exceeds a preset temperature and cannot be reset.

### **8b. Cadmium and its compounds in electrical contacts**

Cadmium (usually as cadmium oxide) may be used in electric contacts in switches, relays, contactors, etc. The exemption for cadmium metal plating has been deleted.

### **9. Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators**

As absorption cooling works on several different types of energy sources such as gas, kerosene, batteries or electricity, absorption fridges are often used in

recreational vehicles (e.g. motor homes and caravans) or remote places where electricity is not available. Another typical application is for minibars in hotel rooms as these fridges are virtually noiseless.

The applied heat and use of a water-ammonia mixture results in a corrosive environment that warrants the use of hexavalent chromium. This exemption has been introduced, since viable alternatives for this specific application have so far not been identified.

### **9b. Lead in lead-bronze bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications**

Lead-bronze bearing shells and bushes are used, amongst others, in compressors for stationary refrigeration and air conditioning equipment. Typical characteristics of such compressors include a long design life (over 50,000 hours for residential applications and over 100,000 for commercial applications) and a hermetic sealing to prevent refrigerant leakage and ensure reliable, uninterrupted operation without service for up to 15 years. Combined with the unique technical aspects of the refrigeration cycle (dry-starts, miscibility of the lubricant, repeated condensing and boiling, etc.), the bearings need excellent self-lubrication properties to meet the high durability and reliability requirements. Due to its lubricious nature, the use of lead as a bearing constituent is critical in these applications. This exemption has been introduced because so far no suitable alternative has been identified, although other materials have been extensively tested.

Bearing shells and bushes made of alloys that contain lead, which acts as a lubricant, may be used only for refrigeration-containing compressors for HVAC applications. This is because oil and grease lubricants are suitable for most bearings and bushes but they cannot be used at the low temperature of these applications.

### **11a. Lead used in C-press compliant pin connector systems**

C-press compliant pin connector systems are one specific type (see explanation for 11b) which has in the past used tin/lead coatings but a lead free substitute has been identified so that this exemption (11a) is no longer permitted for new equipment but may be used to repair of existing equipment where, for example, the PCB will be tin/lead plated and so a replacement connector should also be tin/lead plated. Use of different coating materials can potentially cause reliability problems.

### **11b. Lead used in other than C-press compliant pin connector systems**

Compliant pin connector systems are used to attach connectors or components to double-sided printed circuit boards. The connectors are pushed into suitably sized holes in the PCB and solder is not needed, but for reliable connection both the interior of the holes and the surface of the pins need to be coated with tin/lead. No suitable alternatives have yet been identified that are not susceptible to tin whiskers except for the C-press type which is covered by exemption 11a



## **12. Lead as a coating material for the thermal conduction module c-ring**

A thermal conduction module c-ring serves a specific purpose in the manufacturing of high performance electronic modules. Such modules are the key components of a mainframe central processing unit and typically contain multiple chips. The c-ring functions as a hermetical seal, continuously dissipating heat and preventing oxidation of solder joints.

While substitutes for lead in this application have been investigated, no feasible alternative has so far been identified.

## **13a. Lead in white glasses used for optical applications**

Exemption 13 has been split into one exemption (13a) for lead in white glass and another (13b) for coloured glass containing cadmium and lead. Exemption 13a is for colourless, transparent glass that is used for applications where no lead-free glass has the required properties such as in some types of camera lens, projectors, scanners and other optical equipment.

## **13b. Cadmium and lead in filter glasses and glasses used for reflectance standards**

Filter glass and glass used for reflectance standards is coloured by the addition of cadmium, lead or both cadmium and lead. Filter glass is used in a variety of optical instruments and has precise light absorption wavelengths which are a function of the additive.

## **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. [Expired on 1 January 2011 except in spare parts for equipment placed on the EU market before this date]**

Microprocessors are mounted onto boards or substrates by way of a socket. Such sockets require that a large number of pins (up to 950) are mounted onto the microprocessor for completing the necessary electrical connections. The high customer quality demands for these products mean that such packages are extensively tested, which necessitates high adhesion strength of the pins. This is even more critical at higher pin counts and the application of lead in the proportions specified in this exemption is essential to achieve the necessary properties.

Substitute materials without lead are used by some manufacturers but for high pin counts, the development of alternatives before 1 July 2006 would create significant quantities of waste. This exemption has been introduced to allow for the development of alternative designs without generating excessive amounts of waste.

## **15. Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages**

Flip chips are attached to their packages or PCBs using very small solder bumps and many types use solder bumps containing lead. Lead is used for two main reasons. Its

ductility reduces the risk of damage to brittle parts of flip chip circuitry. Lead also protects against the possibility of thermal fatigue, which results from cyclic temperature changes and is not well understood with lead-free solders. High melting point solder bumps are attached using solder containing typically 37 – 40% lead to the package because this combination has a high resistance to a phenomenon called “electromigration” which in higher power flip chip packages would otherwise cause premature failure of the device. The solder connections to the chip are known as level 1 and level 1 flip-chip connections may contain lead. The external solder connections between packages and PCB known as level 2 are excluded from this exemption as viable alternatives have been developed.

#### **16. Lead in linear incandescent lamps with silicate coated tubes**

An incandescent lamp generates light using a glowing filament heated to white-hot by an electrical current. This light-giving process is known as incandescence.

A linear incandescent lamp is a tubular filament lamp with pin connectors at either end. The glass is coated on the inside with silicate that contains lead. The lead assists in binding the silicate to the glass.

In this context there is no restriction on the use of lead in these lamps.

#### **17. Lead halide as radiant agent in High Intensity Discharge lamps for professional reprography applications**

High Intensity Discharge (HID) lamps produce light by striking an electrical arc across tungsten electrodes housed inside a specially designed inner fused quartz or fused alumina tube. This tube is filled with both gas and metals. The gas aids in the starting of the lamps and the metals produce the light once they are heated to a point of evaporation.

Certain HID lamp types contain lead-iodide ( $PbI_2$ ) as a component in the filling. These lamps are used in professional U.V. applications: the curing, reprography and label printing industries. The lead is used for creating the correct lamp emission spectrum and lamp effectiveness.

In this context there is no restriction on the use of lead halide as a radiant agent in these lamps.

#### **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) [Expired on 1 January 2011]**

Discharge lamps work by sending an electric current through a special gas. Depending on the gas, this either generates light directly or the current generates ultra-violet light, which is converted to visible light by fluorescent powders.

Lead is used as an activator in fluorescent powders for two classes of special fluorescent lamp products: -

1. Sun tanning lamps contain phosphors such as BSP ( $\text{BaSi}_2\text{O}_5:\text{Pb}$ ), with an emission peak of 350 nm; and
2. Certain specialty lamps (applications: diazo-printing reprography, lithography, insect traps, photochemical and curing processes) contain the phosphors such as SMS ( $(\text{Sr},\text{Ba})_2\text{MgSi}_2\text{O}_7:\text{Pb}$ ), generating a broad emission peak centred at 360 nm.

The presence of lead creates the proper lamp emission spectrum and optimum lamp effectiveness.

Exemption 18a applies to the use of lead as an activator in the fluorescent powder of discharge lamps used in the above applications up to 1% by weight for lamps other than sun tan lamps as alternatives to lead will be available by 1 January 2011 when 18a expired.

**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 ( $\text{BaSi}_2\text{O}_5:\text{Pb}$ )**

Discharge lamps work by sending an electric current through a special gas. Depending on the gas, this either generates light directly or the current generates ultra-violet light, which is converted to visible light by fluorescent powders.

Lead is used as an activator in fluorescent powders; sun tanning lamps contain phosphors such as BSP ( $\text{BaSi}_2\text{O}_5:\text{Pb}$ ), with an emission peak of 350 nm. The presence of lead creates the proper lamp emission spectrum and optimum lamp effectiveness. Sun tan lamps have specific safety requirements and no substitutes to lead have yet been developed that exhibit suitable safety characteristics.

**19. Lead with  $\text{PbBiSn-Hg}$  and  $\text{PbInSn-Hg}$  in specific compositions as main amalgam and with  $\text{PbSn-Hg}$  as auxiliary amalgam in very compact Energy Saving Lamps**

There are two main parts to a compact fluorescent lamp (CFL): the gas-filled tube and the magnetic or electronic ballast. Electrical energy from the ballast flows through the gas in the tube causing it to give off ultraviolet light. The ultraviolet light excites a white phosphor coating on the inside of the tube. This coating then emits a visible light, which is the final product of the CFL.

Very compact Energy Saving Lamps (ESL) contain  $\text{PbBiSn-Hg}$  and  $\text{PbInSn-Hg}$  in specific compositions as main amalgam and  $\text{PbSn-Hg}$  as auxiliary amalgam

The substances (both main & auxiliary amalgams) control the Hg-vapour pressure inside small CFLs, stabilizing the light output and lamp effectiveness over a wide temperature range. This makes it possible to replace incandescent lamps by CFLs in a wide range of applications, both indoor and outdoor.

In this context there is no restriction on the use of lead in the form of an amalgam or auxiliary amalgam in these lamps.

## **20. Lead oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays**

Lead is currently used in the glass panel of Liquid Crystal Display (LCD) screens. Two glass substrates are bonded with high precision by inserting glass spacers in between, to keep the same gap. Lead is used there to prevent overheating of the glass, which would result in image distortion and malfunction. It is found in the form of a solder with a concentration of 70% lead by weight, used to create a safe electrical contact on the plane glass surface. Lead containing glass solder is also used to assemble the flat-panel glass envelope.

In this context there is no restriction on the use of lead in the form of an oxide in the glass.

## **21. Lead and cadmium in printing inks for the application of enamels on glasses, such as borosilicate and soda lime glasses**

Borosilicate and soda glass items are printed with scales and warnings in order to improve usability and ensure consumer safety. These markings must be permanently readable.

The printing on the glass uses an ink, which is fired and melts together with the glass surface, and contains significant amounts of lead oxide (37-48% by weight) and cadmium oxide (11% by weight). Applications using this process to print onto borosilicate glass include: coffee jugs; water boilers; electric water kettles; lamp covers; laser tubes; ozone tubes; and medical devices and soda glass is used for lamps.

In this context, there is no restriction on the use of lead and cadmium in the printing inks.

## **23. Lead in finishes of fine pitch components other than connectors with a pitch of 0,65 mm and less**

The electrical terminations of virtually all electronic components (integrated circuits, memory “chips,” diodes, resistors for example) must be plated with a thin layer of metal to make them capable of being soldered to the printed circuit board. Today, these terminal platings are most commonly comprised of a tin-lead (Sn-Pb) alloy.

One of the main reasons lead is included in the plating is to mitigate the formation and growth of tin “whiskers”. Tin whiskers are electrically conductive, crystalline structures of tin that sometimes grow from surfaces where tin (especially electroplated tin) is used as a final finish.

Tin whiskers have been observed to grow to lengths of several millimetres (mm) and in rare instances to lengths up to 10mm. Numerous electronic system failures have been attributed to short circuits caused by tin whiskers that bridge closely-spaced circuit elements maintained at different electrical potentials.

Lead is used as a whisker suppresser in electroplated Sn coating. The concentration of Pb in the plating alloy is typically below 20%, and the thickness of the plating is only about 10 micrometers.

These tin whiskers can cause functional failure of electronic products once they grow long enough to create short circuits between adjacent electrical terminations. Fine-pitch parts are the most susceptible to such failures because the distance between the conductive leads is small. Modern electronic equipment requires the use of such fine-pitch parts to meet the computation speed and/or small size requirements of the market.

For the purpose of this exemption, fine-pitch components are defined as those with electrical terminations spaced with centres 0.65 mm or less apart. In such parts, the distance between adjacent leads is considerably smaller than the centre-to-centre spacing, and is typically 125 to 300 micrometers.

Since this exemption was granted, products in the scope of RoHS have been modified so that this type of component can be used without lead with negligible risk of tin whisker failures. However, older products would be susceptible to whisker failures and so this exemption allows repairs with fine pitch components that contain lead in the terminal coatings

#### **24. Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors**

RFI signal line filters are manufactured by soldering axial leads into machined ceramic multi layer through hole devices (discoidal capacitors or planar arrays) and mounting into metal bodies or connector shells.

Due to the novel construction of the capacitor, it is necessary to use ductile solders to make these solder joints so as to prevent the ceramic cracking as a result of tensile stresses generated during the cooling of the assembly.

The solders used contain lead along with other alloys (primarily indium) to maintain the ductility required. These solders are typically 50% lead and 50% indium.

In this context there is no restriction on the use of lead in the form of lead in solders for these components.

#### **25. Lead oxide in surface conduction electron emitter displays (SED) used in structural elements, notably in the seal frit and frit ring**

Exemption 25 originally allowed lead to be used in frit materials of all types of plasma display panels (PDP) but a lead-free substitute has been identified for standard PDPs so this exemption is now limited to one new type where no substitute yet is available. Surface conduction electron emitter displays (SED) are relatively new on the EU market and differ in design significantly from plasma display panels (PDP). SED are evacuated unlike PDPs which contain a noble gas and only lead-based frits have so far been found to be suitable to create a permanent vacuum tight seal for SEDs.

## **26. Lead oxide in the glass envelope of Black Light Blue (BLB) lamps**

Black light (also Wood's light) is the common name for a lamp emitting electromagnetic radiation that is almost exclusively in the soft near ultraviolet range, and very little visible light.

BLB lamps produce black light that peaks in the soft ultraviolet at a wavelength of 365 nm, with almost no light in the visible spectrum; they appear deep purple violet to the human eye when operating, and black when turned off. These lamps are used to excite UV-sensitive paints and dyes and for other purposes, especially in special effects, security applications, and medicine.

The amount of PbO in the glass envelope is typically 20 wt%, = 18 wt% Pb.

The lead in the form of PbO is essential for creating the proper lamp emission: optimal optical properties: maximum transmission of UV light, and minimum visible light transmission.

In this context there is no restriction on the use of lead in the form of PbO in these components.

## **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 [Expired on 24 September 2010]**

Most professional/commercial transducers are designed to operate at high output levels in severe environments. At these high acoustic power levels and severe environmental conditions, the transducer's solder joints are subjected to continuous mechanical and thermal stresses. These extreme stresses are often aggravated by the extreme temperature environments to which fire and military use are frequently subjected.

Alloys containing lead are used as electrical/mechanical solders to attach copper-clad aluminium and copper voice-coils to tinsel wires in electro-acoustic transducers used for commercial and professional fire and security sounders, and other sound applications such as military headsets. The alloys are Sn63Pb37 and Sn60Pb40 with lead content between 37 and 40%.

In this context there is no restriction on the use of lead in the form of alloys as a solder in these transducers.

## **29. Lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC**

The use of lead in glass leads to a high refractive index (brilliance), a strong dispersion and a high transmission of the light. Additionally, the use of lead in glass introduces further favourable thermal and mechanical properties in melting, forming, cutting and in post-processing.

In electric and electronic equipment this form of glass is used in pure (colourless) or coloured form for decorative and/or functional purposes, such as lamps, chandeliers, decoration of mobile phone covers, clocks and watches.

According to Council Directive 69/493/EEC, full lead crystal consists at least of 28% lead calculated as lead oxide (therefore >30% lead oxide).

Lead is bonded in the silicate matrix of glass and therefore immobilised and not biologically available. The absolute amount of lead depends on the mass of the article.

In this context there is no restriction on the use of lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC.

### **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**

This exemption allows for the use of special high melting point solders that contain about 70% cadmium, to solder the voice-coil wires of a novel design of small and light-weight but high-powered loudspeakers. The loudspeakers that require this exemption are a patented design and operate at close to 300°C and with very high g-forces due to the vibration of the loudspeaker. Few cadmium-free solders have a suitable melting temperature; even so-called high melting point solders which are covered by the exemption mentioned in paragraph 7 above melt at about 300°C. The light-weight design is achieved by the use of aluminium wires and the few cadmium-free solders with a suitably high melting point such as zinc/aluminium are too aggressive and dissolve the aluminium.

### **31. Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)**

This exemption permits the use of lead in the material used to form a gas tight bond for a new type of flat fluorescent lamp that is mercury free and has an unusually long life. Research has not yet identified a material that can form a permanent gas tight bond without lead. Although referred to as a “soldering material”, this is a lead based low melting point glass with ~70% lead oxide which melts on heating the lamp assembly to form the bond and seal the lamp. These lamps can be used as backlights for LCDs, as well as for lighting and other applications. They are thicker than the narrowest types of special straight fluorescent lamps that do need to contain mercury and are used where there is limited space available such as in laptop computers. Lead in these special lamps is already covered by the exemption in paragraph 22 above, but this exemption allows lead in special thin flat lamps but only for LCD.

### **32. Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes**

The optical windows of Argon and Krypton lasers are sealed using special glass frit materials that contain lead oxide. Frit seals are made with low melting point glasses

in powder form and these form a glass bond when heated to above their melting point. The optical windows and the laser tube are both quartz and only seals made with lead based glass provide the correct combination of properties that allow the vacuum tight bond to be made and precisely align the windows with a high yield.

Argon and Krypton lasers are used as tools for cutting materials. They are also used for medical applications such as eye surgery although medical lasers are in Category 8 of the WEEE Directive and, therefore, currently outside the scope of the RoHS Directive.

### **33. Lead in solders for the soldering of thin copper wires of 100 µm diameter and less in power transformers**

Copper transformer wires are connected to terminals by soldering but copper dissolves in the liquid solder. In the time taken to make a solder joint, it is possible for all of the copper to dissolve if the wire is very thin resulting in weak bonds. The rate at which copper dissolves depends on the solder composition, the temperature and time at high temperature. The rate of dissolution is faster in lead-free solder than in tin/lead solder at the same temperature. The slowest dissolution rate is achieved with tin/lead solder alloys that also contain ~3% copper. Standard lead-free solders with <1% copper dissolve the copper wire much more rapidly. Another issue is that it can take longer to make a lead-free bond than a tin/lead bond so that more copper dissolves. High power transformers use very fine wires and generate high voltage and so the solder bond must be domed to avoid arcing and this increases the time required to make the bond. To burn off the enamel coatings used on fine copper wires requires the use of a high temperature and this also increases the copper dissolution rate. Enamel coated transformer wires of 100 µm diameter or less cannot be soldered with lead-free solders as too much copper dissolves resulting in a weak bond and so solders containing lead must be used.

### **34. Lead in cermet-based trimmer potentiometer elements**

Cermet based potentiometers are electronic components used to provide an adjustable electrical resistance. This type of potentiometer is the only type suitable for high current, high humidity or high temperature operation. The device contains a cermet disc with a resistive coating of ruthenium oxide with lead oxide that is applied as a paste which is heated to melt the lead oxide to give a strong, wear-resistant bond. The lead imparts the necessary wear resistance and a stable electrical resistance. Similar coatings of lead with ruthenium oxide are widely used in chip resistors which are generally regarded as being covered by RoHS exemption 7c (lead in electronic ceramic parts) but neither the applicant nor the Commission could determine if the cermet potentiometer application was covered by RoHS exemption 7c or by RoHS exemption 5 (lead in glass of cathode ray tubes, electronic components and fluorescent tubes) and so this exemption has been granted to allow the use of lead in the resistive materials of cermet potentiometers.

### **36. Mercury used as a cathode sputtering inhibitor in DC plasma displays with a content up to 30 mg per display [Expired on 1 July 2010]**



Most plasma displays on the market, including plasma TVs, are AC types which do not contain mercury. However this exemption applies to DC type plasma displays which contain small amounts of mercury. DC plasma displays that show information (eg numbers) are quite different to AC plasma television displays. Inside the display, DC voltages are applied between anodes and cathodes to generate the plasma. With DC, the charge flows in one direction so that electrons hitting the cathode slowly erode the surface by a process referred to as “sputtering”. Mercury vapour within the plasma display effectively retards sputtering of the cathodes giving the display an acceptable life. No alternative materials have yet been found to replace mercury. The exemption is granted only until 1 July 2010 because research into substitute materials is underway.

### **37. Lead in the plating layer of high voltage diodes on the basis of a zinc borate glass body**

High voltage glass diodes are made with a special type of glass based on zinc borate with ~2.5% lead. The glass composition is designed to match the thermal expansion coefficient of the component’s terminals. The terminals are electroplated with a tin coating and during assembly, small quantities of lead from the glass diffuse into the tin coating giving it a composition with up to 0.3% lead. Although the lead in the glass of the diode is covered by exemption No. 5 of the RoHS Annex, the lead that has diffused into the tin coating is not covered by any other existing exemptions.

### **38. Cadmium and cadmium oxide in thick film pastes used on aluminium bonded beryllium oxide**

Hybrid circuits based on alumina substrates are widely used in electronics but for certain specific and demanding applications, beryllium oxide substrates are required. The hybrid circuit consists of a number of layers of insulators, dielectrics and metals that are applied to create the electrical circuit. Semiconductor dies are attached to the circuitry commonly with fine aluminium wires that are bonded to the metal conductors of the hybrid circuit using ultrasonic wire-bonding. The materials of the hybrid circuitry must bond strongly to each other and to the substrate and not de-bond during the thermal processing or when aluminium ultrasonic wire-bonding is carried out. Traditionally, hybrid materials have contained lead and cadmium oxide to form low melting point glasses that melt during processing to create a strong bond. RoHS compliant hybrid materials have been developed that are suitable for the more common alumina substrates but none are yet available that are suitable on beryllium oxide.

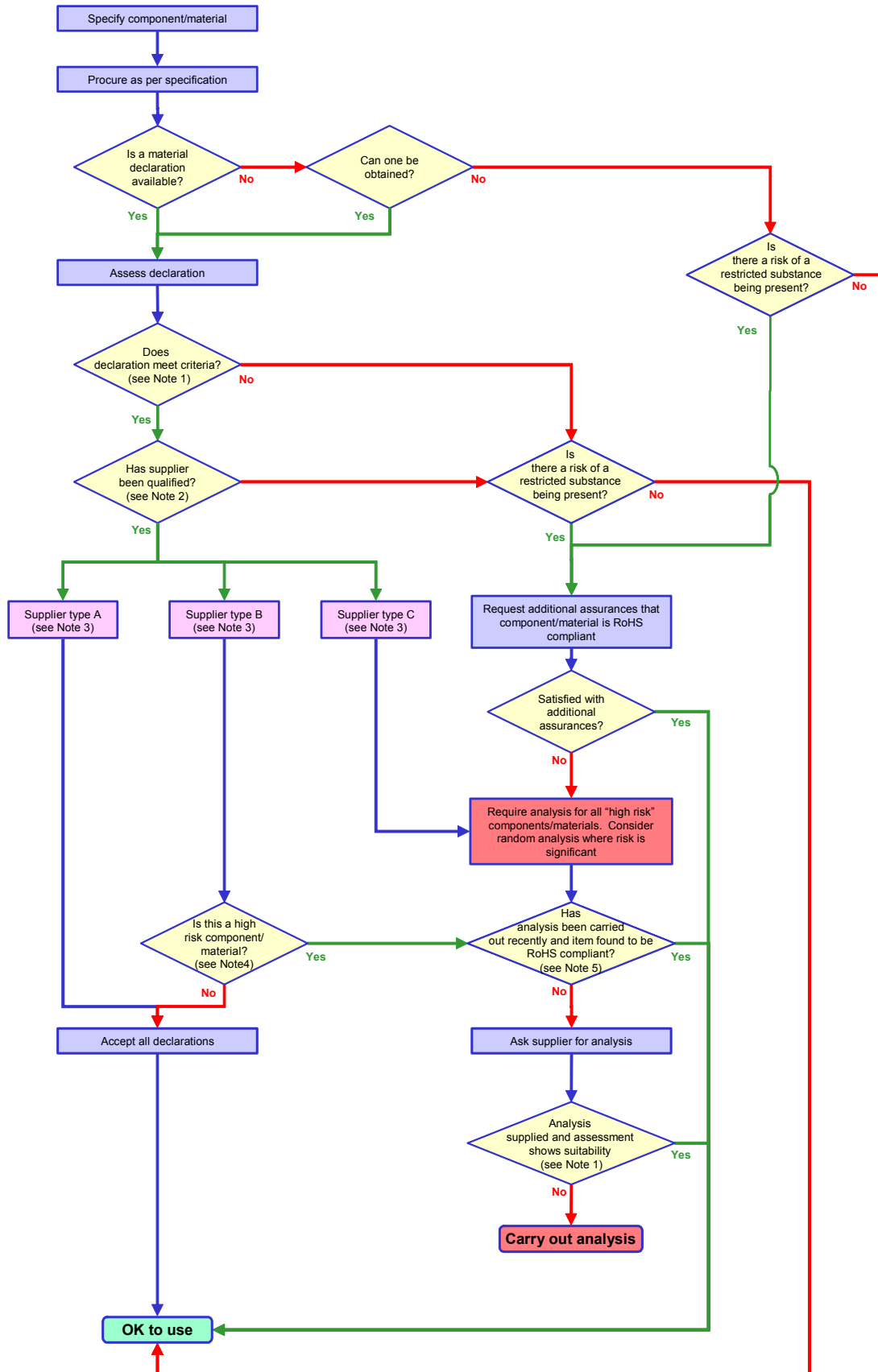
### **39. Cadmium in colour converting II-VI LEDs (< 10 µg Cd per mm<sup>2</sup> of light-emitting area) for use in solid state illumination or display systems**

Light emitting diodes (LED) are produced in four main colours, blue, green, yellow and red. White LED lighting is produced by combining blue, green and red but obtaining a pure white consistently is very difficult as the exact colours of individual LEDs vary, even within one silicon wafer. Another issue is that although the energy efficiency of blue LEDs is high, the energy efficiencies of green and yellow LEDs are much lower. Hence, it is an advantage in terms of reduced energy consumption to use blue LEDs where possible.

Exemption 39 covers a new development in which a thin coating of II – VI compounds is deposited onto energy efficient blue LEDs and this coating converts with a high energy efficiency the emitted blue LED light into light of other colours. II – VI compounds are substances that contain elements from group II of the periodic table (e.g. Zn and Cd) and from group VI (e.g. selenium and tellurium). Cadmium is used in these coatings as it has been found to be an essential ingredient to allow conversion of blue light into the required visible light colours. The emitted light colour depends on the composition of the coating and it is possible to produce light of almost any colour with a defined wavelength. This technology is useful for display applications where precise and reproducible colours are important. By using more than one coating on a blue LED, it is possible to emit blue, green and red light from one colour converted LED to obtain a precise pure white light that can be used for solid state illumination applications.

## Annex D

An example of a flow chart that might be used as part of an organisation's compliance procedures (see notes on next page).



## Notes to accompany the compliance flow chart

### Note 1 - Assessment of materials declarations and suppliers analysis certificates

- Declarations and analysis certificates must be assessed for accuracy. As the forgery of analysis certificates is not unknown, expect to see the following information:
  - Declarations and analysis data based on homogeneous materials
  - A statement that all six RoHS substances are absent and a list of maximum concentration values
  - If an exemption is utilised, a statement to that effect specifying which one this is
  - Supplier name and contact details

### Note 2 – Supplier Qualification

- Has the supplier been qualified?  
Most manufacturers will already have a defined process of supplier qualification as part of their quality system. This system needs to be extended to capture information critical to RoHS. This could be based on audit, past experience, etc.
- Supplier audit guidance
  - Aim is to determine if a supplier understands the requirements of the RoHS Regulations and has procedures in place that minimise risk
  - May be carried out in person or remotely
  - Industry accreditations for RoHS may be acceptable although these do not guarantee compliance
  - Any audit should consider how your suppliers assess their suppliers

### Note 3 – Supplier Qualification Categorisation

- As an output of the qualification process, suppliers are categorised according to their performance. This example suggests three categories:
  - Type A: supplier has very good understanding of RoHS, comprehensive and effective systems in place to ensure RoHS compliance and carries out selective analysis of high risk components/materials
  - Type B: Supplier has good understanding of RoHS and has a system for ensuring RoHS compliance but may be lacking in some respect, e.g. does not analyse high risk components/materials
  - Type C: Supplier does not understand RoHS requirements or does not have system to ensure compliance and does not check incoming components/materials or declarations

### Note 4 – High Risk Components/Materials

- High risk components/materials include the following examples:
  - PVC
  - bright red, orange or yellow plastic

- ABS
- aluminium and galvanised steel with a yellow “tint”

#### **Note 5 – Analysis Requirements**

- The need for regular analysis depends on the risk of non-compliance as well as the risk to the environment. Therefore components/materials used in large numbers will require more frequent scrutiny (and possibly analysis) than those used in small numbers.
- Due diligence does not expect analysis of every component/material, this would be unreasonable but where there is a risk of non-compliance, the frequency that analysis should be carried out may depend on the potential risk to the environment so that components/materials used in very large numbers would need to be analysed more often than components/materials used in small numbers.

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Any enquiries regarding this publication should be sent to:

Department for Business, Innovation and Skills  
1 Victoria Street  
London SW1H 0ET  
Tel: 020 7215 5000

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