Step-by-Step Guide to Compliance with the RoHS Directive

This guide, which is incorporated within the Legislation and Technical Manual available for download at **www.rohs.info**, has been put together in conjunction with ERA Technology to help you understand more about the Restriction of use of certain Hazardous Substances (RoHS) Directive which comes into force on 1st July 2006.

Farnell InOne is committed to becoming the distributor of choice for guiding you through the legislation and providing you with clear information and services. With product status changing on a daily basis, our website provides up to the minute news and information together with the very latest listings of RoHS compliant products.

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Legislation and Technical Manual
Providing information on exemptions to the RoHS Directive as well as guidance on what declarations of compliance should be requested from suppliers. Among other topics covered are maximum concentration values, homogenenous material, analysis, where restricted substances are likely to be found as well as a dedicated section on lead-free soldering.

Does your product need to comply with the RoHS Directive? 1

- The Directive applies to electrical and electronic equipment that is dependent on electric or electromagnetic fields in order to work properly (and equipment for the generation, transfer and measurement of such currents and fields) which falls within the categories listed on page xi and designed for use with a voltage rating not exceeding 1,000 volts for alternating current and 1,500 volts for direct current.

Contact suppliers and ask if their materials, parts, components, etc. contain any of the six restricted substances. 2

- Lead, cadmium, mercury, hexavalent chromium, PBB or PBDE flame retardants.
- Suppliers should provide a materials declaration or certificate of conformity which could be in various formats.

Is there any doubt about the presence of a restricted substance? 3

- Use the decision tree that appears on page xiii to decide if analysis is advisable.
- The frequency of analysis will depend on many factors, including your relationship with suppliers, and high risk substances.

Some suppliers may not change their part numbers so separation of RoHS compatible and RoHS incompatible parts will be needed. 4

Keep supplier declarations and analysis data in a technical file. 5

- The authorities will expect to see this in case of a suspected infringement.

Your customers may ask about RoHS compliance and expect you to provide a Certificate of Compliance. 6

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Step-by-Step Guide to Compliance with the RoHS Directive

The Restriction of the use of certain Hazardous Substances (RoHS) Directive comes into force on 1st July 2006.

What is a compliant product?

The RoHS Directive applies to equipment that is within the scope of the Directive (see page xi). None of the "homogeneous materials" within compliant products must contain the six restricted substances at concentrations above the "maximum concentration values".

Who is responsible?

Producers of equipment are held responsible for ensuring that their products do not contain the six restricted substances. The Directive does not cover components or sub-assemblies and so the equipment producers will have to take their own steps to ensure that all parts and materials used in their products do not contain restricted substances.

"Producer" means any person who, irrespective of the selling technique used:

- manufactures and sells electrical and electronic equipment under his own brand;
- resells under his own brand equipment produced by other suppliers; or
- imports or exports electrical and electronic equipment on a professional basis into a member state.

It is clear from this that there will be circumstances in which it is not the actual manufacturer of a product who will assume the "producer" responsibilities.

What are the maximum concentration values (MCV)?

These have not been formally agreed at the time of going to print, but are likely to be 0.1 weight percent of lead, mercury, hexavalent chromium, PBB and PBDE and 0.01 weight percent cadmium in homogeneous materials.

What is a homogeneous material?

A homogeneous material is a unit that cannot be mechanically disjointed (for example by cutting, grinding, crushing) in single materials such as plastic, ceramics, glass, metals etc - see graphic below - the homogeneous material is the pin (lead-frame) coating.

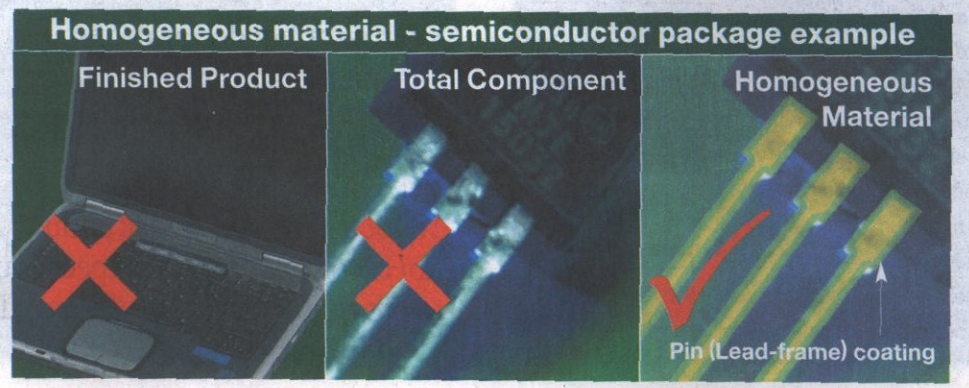
What will producers be required to do to comply with RoHS legislation?

By placing their products on the market, producers are declaring that these comply with RoHS legislation. This is the basis for "self-declaration" which is used for several other European Union Directives. There are no requirements for the application of a specific mark or testing by independent third parties. However, the authorities within each Member State will carry out market surveillance and conduct checks on products. If they find that a product does not comply with RoHS legislation, the producer will be asked to show that due diligence has been used and he has taken "reasonable steps" to comply. This legal defence is used for other legislation, but what constitutes "reasonable steps" has not been defined.

Producers will be expected to use two approaches to comply:

- Obtain declarations of compliance for materials, components and other parts from suppliers.
- Selected analysis.

Where authorities find non-compliant equipment, they will audit the producer's records, which should be in the form of a "technical file". These files must be kept for at least four years.



Electrical and electronic equipment included in the RoHS Directive

The examples listed below each category heading are not intended to be exhaustive and other items may be regarded as within the scope of the legislation.

Large household appliances

- Refrigerators, freezers and 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

Small household appliances

- 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 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

IT and telecommunications equipment

- Centralised data processing
- Mainframes
- Minicomputers
- Printer units
- Personal computing: Personal computers (CPU, mouse, screen and keyboard included)
- Laptop computers (CPU, mouse, screen and keyboard included), Notebook computers, Notepad computers
- Printers
- Copying equipment
- Electrical and electronic typewriters
- Pocket and desk calculators
- And 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, cordless, cellular telephones
- Answering systems
- And other products or equipment of transmitting sound, images or other information by telecommunications

Consumer equipment

- Radio sets
- Television sets
- Video cameras
- Video recorders
- Hi-fi recorders
- Audio amplifiers
- Musical instruments
- And 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

Lighting equipment

- Luminaires for fluorescent lamps with the exception of luminaires in households
- Straight fluorescent lamps
- Compact fluorescent lamps
- High intensity discharge lamps, including pressure sodium lamps and metal halide lamps
- Low pressure sodium lamps
- Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

Electrical and electronic tools

(with the exception of large-scale stationary industrial tools)

- 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 rivetting, nailing or screwing or removing rivets, nails, screws or similar uses
- Tools for welding, soldering or similar use
- Equipment for spraying, dispersing or other treatment of liquid or gaseous substances by other means
- Tools for mowing or other gardening activities

Toys, leisure and sports equipment

- 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

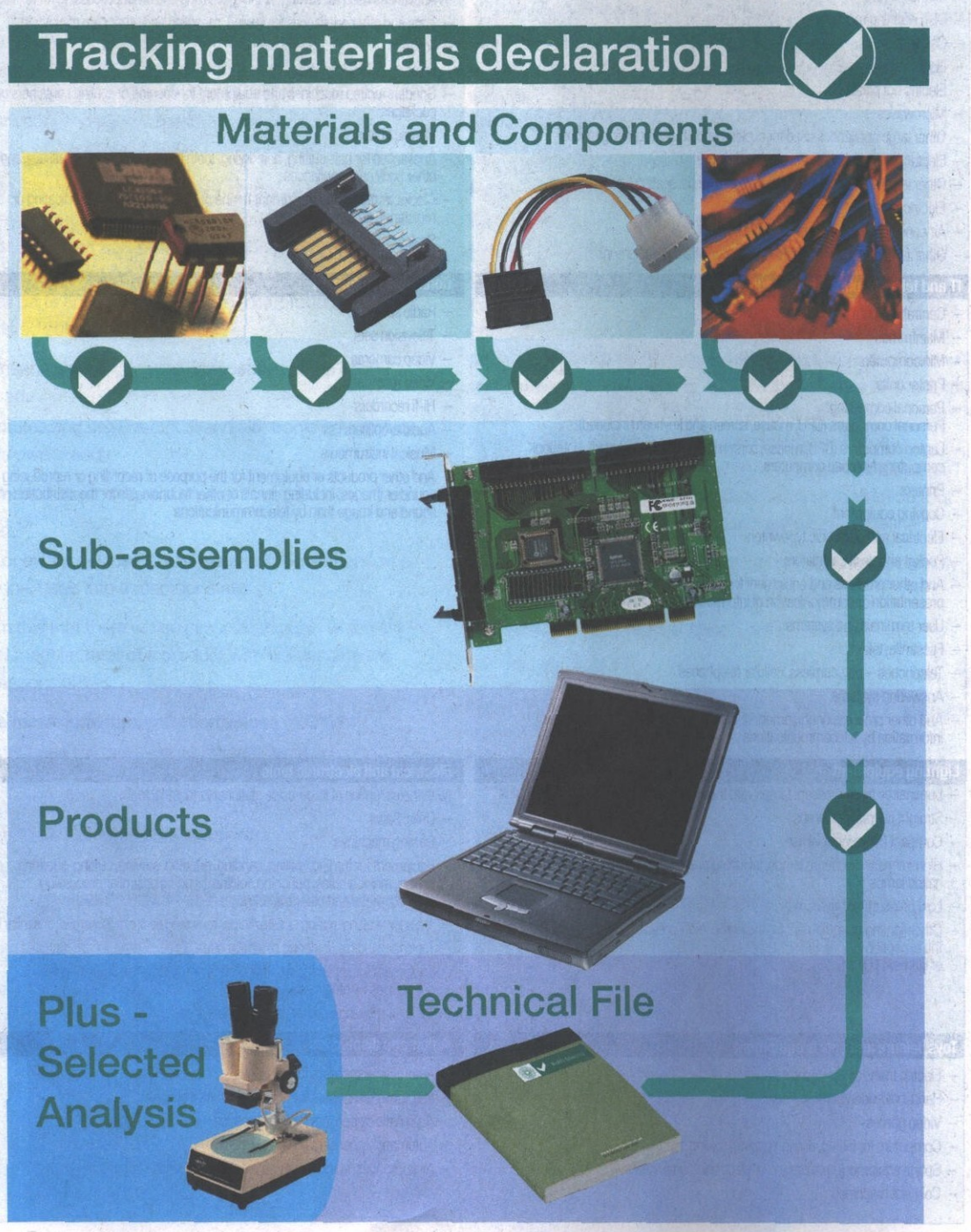
Automatic dispensers

- 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 kinds of products

Tracking materials declaration for RoHS Compliance

The absence or presence of the six restricted substances is tracked throughout the supply chain. For example, a notebook PC manufacturer will obtain declarations on individual components and sub-assemblies, as well as carrying out selected analysis.

Materials declarations may be in paper or electronic format.



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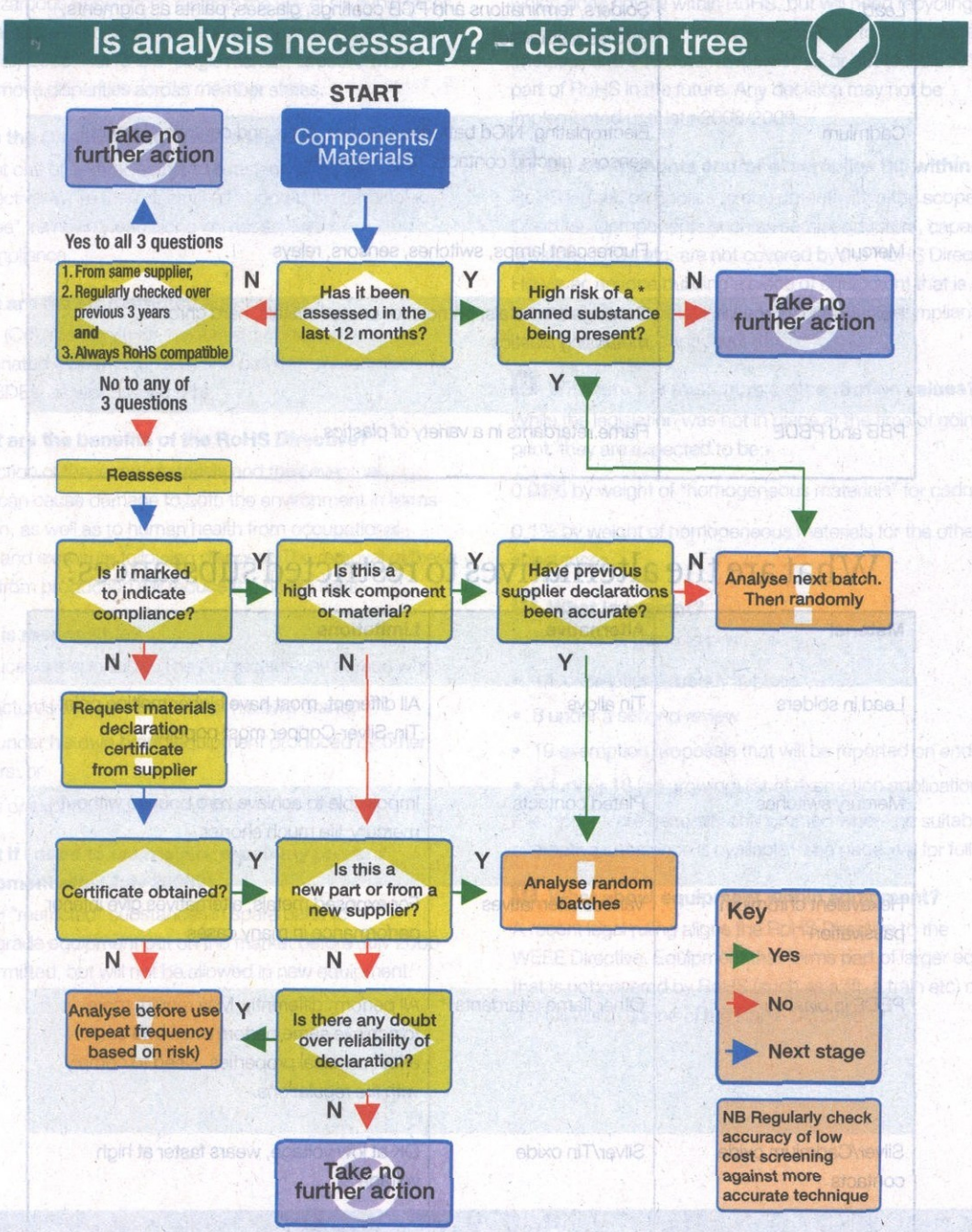
Selected analysis – when to analyse?

There may be occasions when it will be advisable for a producer to carry out analysis to determine whether a restricted substance is present. There are various reasons why this might be necessary, but the decision whether to analyse is left to the equipment producer.

ERA Technology developed an example of a decision tree to help producers decide whether analysis is necessary and this was included in the Government's Proposed Guidance Notes on the UK RoHS legislation. A modified version is shown below:



*There are certain materials that have a relatively high risk of containing a restricted substance. For example, PVC obtained from the Far East often contains lead and cadmium and these are occasionally found in other types of plastics.

In addition, there may be significant variation between different batches and therefore an equipment producer using multiple batches should be aware of this issue.

Where restricted materials can be found

Material	Where found
Lead	Solders, terminations and PCB coatings, glasses, paints as pigments, PVC as a stabiliser
Cadmium	Electroplating, NiCd batteries, plastics, glass and ceramic pigments, sensors, electric contacts, relays, switches
Mercury	Fluorescent lamps, switches, sensors, relays
Hexavalent Chromium	Coatings on metals, primers for coated metals, hard chrome, metallising plastics
PBB and PBDE	Flame retardants in a variety of plastics

What are the alternatives to restricted substances?

Material	Alternative	Limitations
Lead in solders	Tin alloys	All different, most have higher melting point. Tin-Silver-Copper most popular.
Mercury switches	Plated contacts	Impossible to achieve zero bounce without mercury, life much shorter
Hexavalent chromium passivation	Various alternatives	For exposed metals, alternatives give inferior performance in many cases
PBDE in plastics	Other flame retardants	All perform differently. May require more to achieve same performance and could affect physical properties. Need to comply with fire regulations.
Silver/Cadmium oxide contacts	Silver/Tin oxide	OK at low voltage, wears faster at high voltage

Lead-Free Soldering Guide

With the introduction of lead-free solders, the following points should be considered when deciding to upgrade, or change solder tools used in a leaded soldering process.

1. **Lead-free alloys now being specified melt approx. 40°C higher than current tin/lead alloys.**
2. **Lead-free alloys do not flow (wet) as readily to form the joint and will therefore take slightly longer to form the solder joint.**
3. **Solder Iron tip temperature is only one measure of the available energy to solder. Power and thermal recovery (speed to reach optimum temperature) are equally important.**

Warning

Increasing tip temperatures can be counter productive, as the hand soldering process relies on the operator applying the heat and removing the iron once the joint has formed. If the tip temperature is increased and the operator lingers on the joint due to the slower wetting time, the joint reliability will be questionable as over heating can cause brittle joints and higher tip temperatures will lead to the flux boiling off too soon (flux in solder forms acids that aid the solder process).

Useful Q & A's

Q. What is the operating temperature range of your current soldering equipment?

A. Typically 330°C-390°C is normal. If towards the lower end of the scale a change of equipment may be required to ensure an efficient lead-free process. Operators soldering at the higher end of the scale need to be sure the tools they are using have sufficient spare power to cope with the higher demand of a lead free process.

Q. What is the response time of your iron?

A slow responding iron will not recover heat quickly enough to solder lead-free joints repeatedly.

As a guide, if the iron reaches operating temperature from switch on within 10-15 seconds this would be considered good. If the heat up time approaches one minute, this would be considered poor.

Q. Do you have any assemblies you find tough to solder with tin/lead alloys?

If "yes", it's highly likely that unless better tools are used lead free soldering will not be possible.

Q. What is the power rating of your iron and how efficient is it?

Lower powered irons (25-40W) may struggle with lead-free as their reservoir of stored energy may become depleted too quickly. Higher powered irons (80W) are generally more reliable; however, not all will transfer heat efficiently, or recover heat quickly so power must be coupled with efficiency.

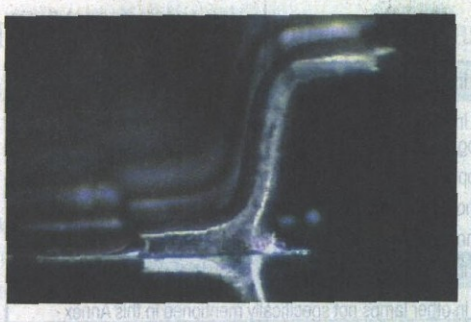
Q. Other than equipment change, what can be done to improve heat transfer efficiency?

As a rule, tips with a lower mass improve heat transfer efficiency and speed up recovery time.

Q. Are your tips lead free compatible?

Solder tips have little or no lead content, however, tinning the tip with lead free solder prior to soldering will eliminate the risk of lead contamination during the soldering process.

Lead-Free Soldering Guide



Examples of Tin/Lead solder joints

Examples of Tin/Silver/Copper solder joints

Alloy composition	M.pt. °C	Comments
Eutectic tin/lead solder	183	Included for comparison. Good wetting and low melting temperature
Sn0.7Cu	227	Used for wave soldering applications (known as 99C), high melting temperature and wetting inferior to SnAg
Sn3.5Ag	221	Used as high temperature solder, wetting inferior to SnAgCu
Sn3.5Ag0.7Cu (and variations on this)	217	Most widely used lead-free alloy. Various percentages of silver and copper are used. Melting temperature 34°C higher than tin/lead and inferior wetting
SnAgBi alloys (some with Cu)	Ca. 210 -215	Better wetting properties than SnAgCu but must not be used with lead. Mainly used as solder pastes but has been used for wave soldering, mainly in Japan.
Sn9Zn	198	Needs special flux and is susceptible to corrosion
Sn8Zn3Bi	Ca. 191	Used by several Japanese manufacturers where heat sensitive components are used. Difficult to use
58Bi42Sn	138	Low melting point, hard, brittle alloy

The Current Position on Exemptions to the RoHS Directive

In place

1.	Mercury in compact fluorescent lamps not exceeding 5 mg per lamp
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
3.	Mercury in straight fluorescent lamps for special purposes
4.	Mercury in other lamps not specifically mentioned in this Annex
5.	Lead in glass of cathode ray tubes, electronic components and fluorescent tubes
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
7.	▸ lead in high melting temperature type solders (i.e. lead-based alloys containing 85 % by weight or more lead) ▸ lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications ▸ lead in electronic ceramic parts (e.g. piezoelectronic devices)
8.	Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC (1) amending Directive 76/769/EEC (2) relating to restrictions on the marketing and use of certain dangerous substances and preparations
9.	Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators
10.	Lead used in compliant pin connector systems
11.	Lead as a coating material for the thermal conduction module c-ring
12.	Lead and cadmium in optical and filter glass
13.	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
14.	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages

Additional during 2005

1.	Lead in tin whisker resistant coatings for fine pitch applications
2.	Lead bound in glass, crystal glass, lead crystal or full lead crystal in general and Chromium (also in oxidation state (VI)) and Cadmium as colouring batch addition each form up to a content of 2 % in glass, crystal glass, lead crystal or full lead crystal used as decorative and / or functional part of electric or electronic equipment
3.	Solders containing lead and/or cadmium for specific applications
4.	Hexavalent chromium (CRVI) passivation coatings
5.	Lead in lead oxide glass plasma display panels
6.	Lead in connectors, flexible printed circuits, flexible flat cables
7.	Lead oxide in lead glass, bonding materials of magnetic heads and magnetic heads
8.	Cadmium as doping material in avalanche photodiodes (APDs) for the optical fiber communication systems
9.	Lead in optical isolators
10.	Lead in sheath heater of Microwaves
11.	Cadmium pigments except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to the restriction on the marketing and use of certain substances
12.	High Intensity Discharge (HID) lamps for professional U.V. applications, containing lead halide as radiant agent
13.	Discharge lamps for special purposes containing lead as activator in the fluorescent powder (1% lead by weight or less)
14.	Discharge lamps containing lead in the form of an amalgam
15.	Mercury free flat panel lamp Mercury free flat panel lamp
16.	Special purposes Black Light Blue (BLB) lamps, containing lead in the glass envelope
17.	Low melting point alloys containing lead
18.	Galvanised steel containing up to 0.35% lead by weight and aluminium with an unintended lead content up to 0.4% lead by weight in electrical and electronic equipment
19.	Cadmium sulphide photocells

Under review (at time of going to print)

1.	Lead based alloys containing 85 % by weight or more lead
2.	Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications
3.	Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive
4.	Lead used in compliant pin connector systems
5.	Lead as a coating material for the thermal conduction module c-ring
6.	Lead and cadmium in optical and filter glass
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