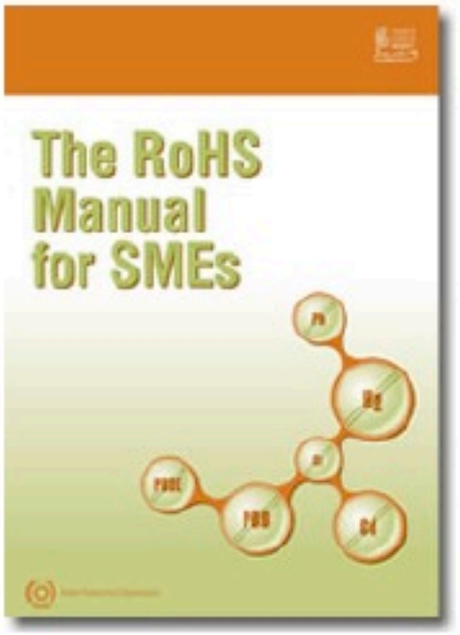
From:

The RoHS Manual for SMEs

©APO 2008, ISBN: 92-833-7073-2

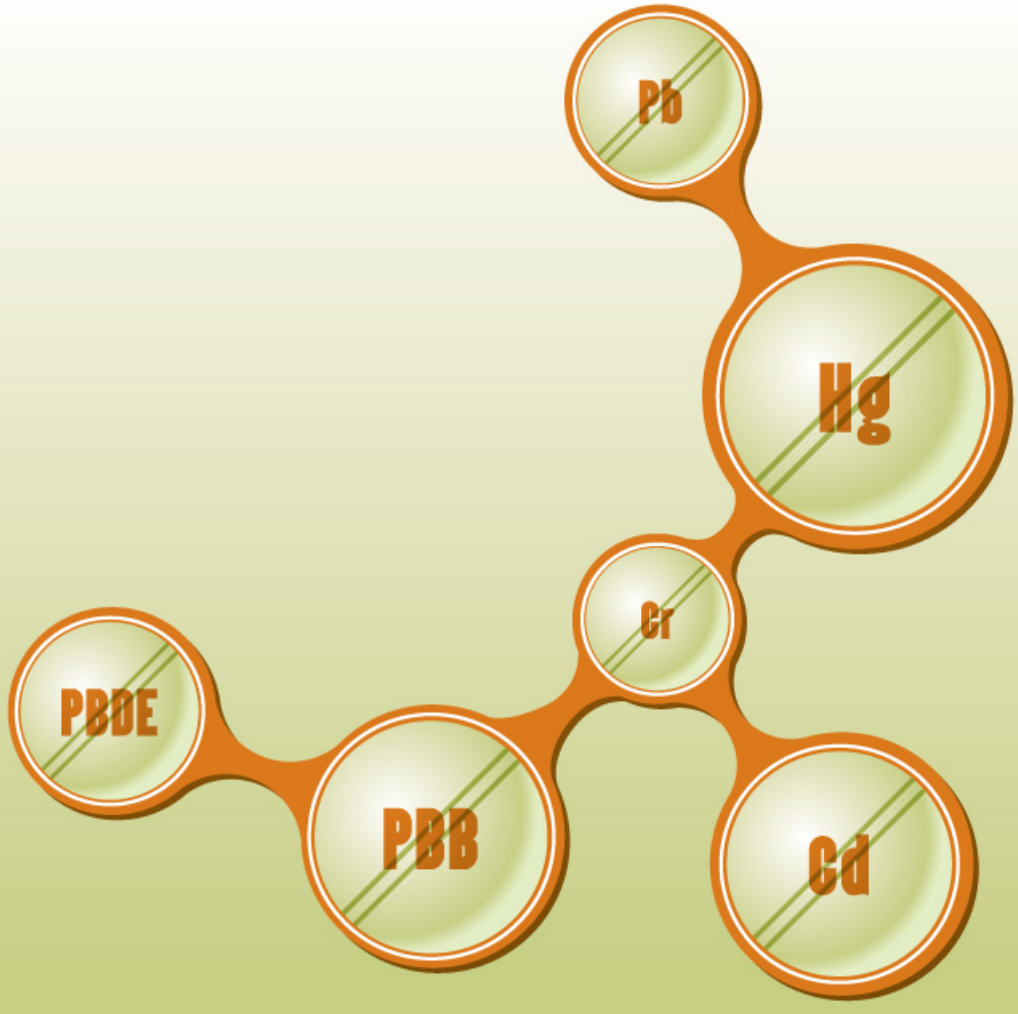
Edited by Dr. Kun-Mo Lee, Republic of Korea



Published by the Asian Productivity Organization
1-2-10 Hirakawacho, Chiyoda-ku, Tokyo 102-0093, Japan
Tel: (81-3) 5226 3920 • **Fax:** (81-3) 5226 3950
E-mail: apo@apo-tokyo.org • **URL:** www.apo-tokyo.org

APO WORLD CONFERENCE ON GREEN PRODUCTIVITY

The RoHS Manual for SMEs



Asian Productivity Organization

RoHS Manual for SMEs

Asian Productivity Organization
2008

Dr. Kun-Mo Lee, Republic of Korea, served as the volume editor.

ISBN: 92-833-7073-2

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

AC – Alternating Current

BLB – Black Light Blue

CAS – Compliance Assurance System

CEO – Chief Executive Officer

CFCs – Chlorofluorocarbons

CRT – Cathode Ray Tube

DB – Database

DC – Direct Current

EC – European Community

EEC – European Economic Community

EEE – Electrical and Electronic Equipment

ELV – End of Life Vehicles

EMS – Environmental Management System

EPU – European Payments Union

ESL – Energy Saving Lamps

EU – European Union

GC-MS – Gas Chromatography-Mass Spectroscopy

HCFCs – Hydro-Chlorofluorocarbons

HDD – High Density Discharge

IC – Integrated Circuit

ICP – Inductively Coupled Plasma spectroscopy

IEC – International Electrotechnical Commission

ISO – International Organization for Standardization

JGPSSI – Japan Green Procurement Survey Standardization Initiative

LCD – Liquid Crystal Display

MCV – Maximum Concentration Volume

MDL – Method Detectic

MLCC – Multilayer Ceramic Capacitor

MSDS – Material Safety Data Sheets

NWML – National Weights and Measurements Laboratory

PBB – Polybrominated Biphenyl

PBDEs – Polybrominated Diphenyl Ethers

PCB – Printed Circuit Board

PCBs – Polychlorinated Biphenyls

PCNs – Polychlorinated Naphthalences

PCTs – Polychlorinated Terphenyls

PDCA – Plan, Do, Check and Act

PDP – Plasma Display Panel

PTC – Positive Temperature Coefficient

PVC – Polyvinyl Chloride

PWB – Printed Wiring Board

REACH – Registration, Evaluation, Authorization, and Restriction of Chemicals

RoHS – Restriction of the Use of Hazardous Substances

SED – Surface-conduction Electron-emitter Display

SMEs – Small and Medium Enterprises

TAC – Technical Adaptation Committee

WEEE – Waste Electrical and Electronic Equipment

XRF – X-ray Fluorescence

FOREWORD

The APO has been striving to enhance the productivity and competitiveness of small and medium-scale enterprises (SMEs) in the business and manufacturing sectors, as the industrial scenario in the Asia-Pacific region is dominated by SMEs. To assist SMEs in the electrical and electronic sector, the APO organized a workshop on The Restriction of Hazardous Substances (RoHS) in association with SPRING, Singapore, in 2007. The RoHS Directive of the European Union came into effect in July 2006, significantly affecting the business of SMEs in this sector.

The RoHS Directive restricts the use of six hazardous materials in the production of various electrical and electronic equipment. They are lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ether. This means that any equipment containing more than the designated levels of these six materials is not accepted in the European Union market. Products under the purview of RoHS include batteries, color TVs, automotive electronics, computer systems and components, peripherals, electronic security, light-emitting diodes (LEDs) and LED displays, media players and recorders, networking products, personal electronic devices, printed circuit boards, passive components, etc. Given the broad coverage, this directive has directly and indirectly affected a huge number of enterprises in the Asia-Pacific region.

Based on the workshop deliberations, compliance with the RoHS Directive in the Asia-Pacific region is still not complete. The degree of compliance varies among industries and SMEs in the manufacturing supply chain are finding it particularly difficult to comply. This has affected international exports significantly. The most important requirement is evolving country-specific regulations in line with RoHS. Sustaining and increasing business in the European market makes compliance with the RoHS Directive essential. Companies in the Asia-Pacific need to make the necessary changes in manufacturing processes and replace hazardous materials with safe ones.

Recognizing the economic significance of RoHS for its member countries and in line with its objective of assisting industries to be more competitive, the APO decided to develop a manual on RoHS as a guide for SME compliance. The manual will be disseminated as widely as possible among industries operating in the electrical and electronic sector. Major RoHS requirements and control processes to meet them are covered, illustrated by case studies. It is hoped that this RoHS manual for SMEs will help clarify perceptions of the requirements involved, thereby allowing more SMEs in member countries to become compliant and expand their market access.

Shigeo Takenaka
Secretary-General
Tokyo

November 2008

ABOUT THIS MANUAL

This manual is intended to help small- and medium-size enterprises (SMEs) comply with the European Union's Reduction of Hazardous Substances (RoHS) Directive. This publication consists of three chapters respectively covering RoHS Requirements, Helping SMEs Achieve RoHS Compliance, and RoHS Compliance Case Studies. It is our hope that SMEs can have better understanding of the RoHS Directive and develop an effective RoHS management system that satisfies the RoHS requirements placed on their customers. As a result, SMEs can remain as the suppliers to the customers in compliance with EU regulations.

Chapter 1 explains and interprets definitions, requirements, and product assessment to check for inclusion within the scope of the RoHS regulations.

Chapter 2 discusses two major topics: understanding the producer's supplier control process, and how suppliers can set up their own parts control process.

Chapter 3 provides case examples from Republic of Korea, Japan, and China to show how the information in the first two chapters is applied in actual practice. The example of a Korean parts maker focuses on all elements required to be RoHS compliant. Although the example from a Japanese parts maker does not show all the elements explicitly, it includes all of them in its actual practice. The Chinese example gives a somewhat different approach in controlling parts suppliers. While the Korean and Japanese parts makers themselves control their suppliers to ensure RoHS compliance, the Chinese company relies on third-party verification and certification of its RoHS management system.

1. RoHS REQUIREMENTS

All requirements and definitions in the EU Directive entitled "Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)" are delineated in this chapter. Explanation and interpretation of the requirements and definitions with relevant examples from the perspective of the Asian electronics industry are elaborated in this chapter in a simple and easily understandable manner. In the event the definitions or requirements are self evident, either explanation or examples are omitted.

EU member states are required to make national laws of their own to carry out the RoHS Directive. In this case, the directive becomes the RoHS regulations. The directive is for EU-wide application and sets the framework for the RoHS requirements, while the resulting regulations are on the national level where actual enforcement of the RoHS Directive takes place. Thus both terms "directive" and "regulations" will be used as appropriate in this chapter.

This chapter consists of three sections and four annexes. The three sections are: definitions, requirements, and assessing products to check whether they are included within the scope of RoHS regulation. Annex I lists product types and products belonging to the product categories regulated under the RoHS Directive. Annex II lists exemptions for which the RoHS directive does not apply. Annex III lists product types in grey areas where uncertainties exist to an extent that the RoHS Directive does not apply. Annex IV lists exemptions of specific applications of lead, mercury, cadmium, hexavalent chromium, and brominated flame retardants (PBDE) used in parts and products.

The information in this chapter comes from the EU Commission's "Frequently Asked Questions on RoHS and WEEE" (EC FAQ, 2005), the RoHS Directive itself (EC RoHS directive, 2003) and other pertinent RoHS-related web sites, in particular the UK government's RoHS regulation-government guidance notes (UK government, 2007).

1.1 DEFINITIONS

There are several key definitions in the RoHS Directive which may cause confusion in interpretation. Thus, the EC published an on-line FAQ (frequently asked questions) to clarify the intention of the EU on the definitions in the directive. Some of these definitions are:

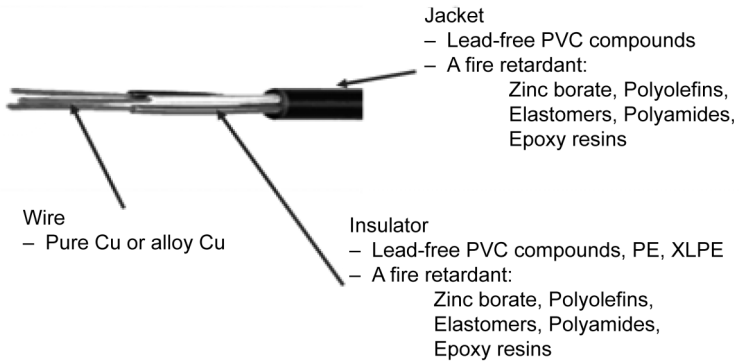
1.1.1 Homogeneous materials

Homogeneous means "of uniform composition throughout." Homogeneous material means "a material that cannot be mechanically disjointed into different materials."

Example:

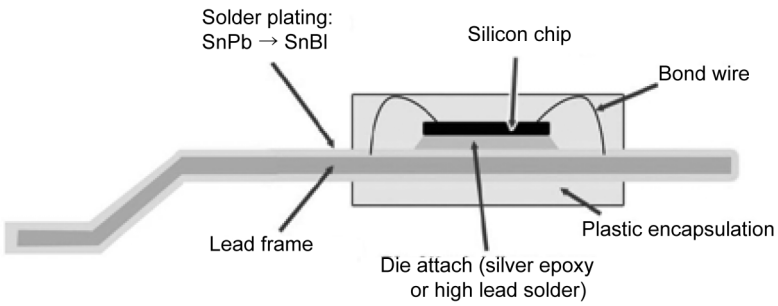
- Individual types of materials, for instance, plastics, ceramics, glass, metals, alloys, paper, board, resins, and coatings.
- A plastic cover is a "homogeneous material" if it consists of one type of plastic that is not coated with or has attached to it or inside it any other kinds of materials. In this case the maximum concentration value (MCV) limits of the directive would apply to the plastic.

- An electric cable that consists of metal wires surrounded by non-metallic insulation materials is an example of a "non-homogeneous material" because the different materials could be separated by mechanical processes. In this case the limit values of the directive would apply to each of the separated materials individually.



Source: http://www.stormcable.com/uploads/Lead_Free_Cable_Compounds.pdf
http://www.imswire.com/pdfs/IMS%20RoHS%20Information.pdf

- A semiconductor package, for which the example shown here is an integrated circuit (IC) chip, contains many homogeneous materials. These include plastic molding material (plastic encapsulation), bismuth-electroplating coatings (solder plating), lead frame, gold-bonding wire (bond wire), and silicon chip. In this example, the parts supplier had replaced lead in the solder plating by bismuth to comply with the RoHS Directive.



Source: Business Management Office, Semiconductor Business, Samsung Electronics Co., Ltd (2007)

Example: Pb (lead) present in the coating of a power cable
Supplier A submitted an analytical report for a power cable to a customer, a producer. The report contains information about substances in the materials used to make the cable. The materials included PVC, paint, and ink. The producer subsequently approved the cable, believing that it complied with RoHS regulations. However, Pb, a hazardous substance, was detected later during a screening test of the supplied part.

In this case, the possibility of the presence of hazardous substances in other materials comprising the cable was overlooked. These other materials, including a chemical stabilizer and flame retardant, should have been checked for the presence of hazardous substances (in particular during the compounding process of the raw materials). Thus, the producer should additionally ask for an analytical report on the homogeneous materials comprising the PVC cable and make the decision of RoHS acceptability based on that report.

Example: Hexavalent chromium detected in a plated part
Supplier B manufactures electro-plated brackets. It analyzed the part and found it contains hexavalent chromium at 3mg/kg. The analytical result was submitted to its customer (a producer) and failed to pass the producer's spot test.*

* *This spot test is a screening process conducted by applying a coloring agent (diphenyl-carbazide) to the surface of the plating layer. If a reddish-purple color develops, hexavalent chromium is present.*

In this case, although the concentration of hexavalent chromium is high in the plated layer, the weight of the layer is much less than the base material. Thus, test results can be misleading by showing that it meets the limit value for the total amount of material used. Separation of the plated layer is difficult; but even if separation is possible, gathering enough mass for the analysis can be challenging. Therefore, it is often more effective to analyze the raw plating liquor and base material separately and to perform the spot test at the same time.

1.1.2 Mechanically disjointed

The materials can, in principle, be separated by various mechanical actions such as: unscrewing, cutting, crushing, grinding, and abrasive processes.

1.1.3 Putting on the market (also, placing on the market)

The initial action of making a product available for the first time on the EC market, with a view to distribution or use in the EC; hence, products are not considered to have been put or placed on the market before they have entered the territory of the EC customs union.

Placing on the market presupposes that the product has been transferred from the stage of manufacturing to the stage of distribution. The distribution chain can also be the commercial chain of the manufacturer or its authorized representative.

Example:
Placing on the market is considered not to take place where a product is:

- transferred to a manufacturer for further measures (i.e., assembling, packaging, processing, or labeling);
- not (yet) granted release for free circulation by customs, or has been placed under another customs procedure (for example, transit, warehousing, or temporary importation), or is in a free-trade zone
- in the stocks of the manufacturer or the authorized representative established in the EC, where the product is not yet made available;
- when a product is stored in a warehouse of a manufacturer, and it is not yet made available on the market. Therefore, the transfer to get the product from the place where it is manufactured – whether outside or inside the European Union – to a manufacturer's warehouse does not constitute placing on the market.

1.1.4 Maximum concentration value (MCV)

A maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE), and of 0.01% weight in homogeneous materials for cadmium.

1.1.5 Electrical and electronic equipment (EEE)
This refers to equipment that is dependent on electric current or electromagnetic fields in order to work properly, and equipment for the generation, transfer, and measurement of such currents and fields falling under the categories set out in Annex IA to Directive 2002/96/EC (WEEE) and designed for use with a voltage rating not exceeding 1,000 volts for alternating current and 1,500 volts for direct current.

1.1.6 Producer (UK government, 2007)
The classification of any individual who, irrespective of the selling technique used, including by means of long-distance communication, seeks to:

- manufacture and sell electrical and electronic equipment under his or her own brand;
- resell under his or her own brand equipment produced by other suppliers, with a reseller not being regarded as the "producer" if the brand of the producer appears on the equipment, as provided for in sub-point (i);
- imports or exports electrical and electronic equipment on a professional basis into an EC member state. Whoever exclusively provides financing under or pursuant to any finance agreement shall not be deemed a "producer" unless he or she also acts as a producer within the meaning of sub-points (i) to (iii).

1.1.7 Due diligence (UK government, 2007)
A business or person having taken all reasonable steps or precautions and having exercised all due diligence to avoid committing an offense under the regulations.

In terms of RoHS compliance, this means that you control your own production process and suppliers based on a hazardous substance management system. It is recommended that all the activities of the business that may cause a breach of the RoHS Directive should be identified, controlled, and checked by the system. The system should be documented and its implementation results documented and kept on record for auditing purposes. The implementation of the system should be audited and the performance of the system be reviewed just like in any other management system (e.g., Plan, Do, Check, and Act cycle).

Example:
A supplier part control process is a process employed by a supplier to control the RoHS-regulated hazardous substances in EEE parts. Most producers operate hazardous substance management systems for their own manufacturing process control. Installing the system and operating can be envisaged as exercising due diligence for the compliance of the RoHS Directive.

1.2 REQUIREMENTS

(Source: 2002/95/EC, RoHS Directive 2003)

1.2.1 Article 2 (2)

"This Directive shall apply without prejudice to Community legislation on safety and health requirements and specific Community waste management legislation."

If devices are not specifically designed to be used in vehicles, those devices would be covered by the RoHS Directive. If the devices are designed primarily for use in vehicles then the End of Life Vehicle (ELV) Directive applies.

Example:
Car radios are not regulated under the RoHS Directive.

1.2.2 Article 2 (3)

Spare parts for the repair, or the reuse, of electrical and electronic equipment put on the market from 1 July 2006.
The directive does not apply to parts for use in equipment put on the market before 1/07/2006 with the purpose of extending its life by updating its functionality or upgrading its capacity.

1.2.3 Article 3 (a)

Equipment "which is dependent on electric current or electromagnetic fields in order to work properly, and equipment for the generation, transfer and measurement of such currents and fields."

"Dependent" means the equipment must be dependent on electric current or electromagnetic fields. In other words, electricity is the primary energy (i.e., not petrol or gas). It also means that when the electric current is off, the appliance cannot fulfill its primary function.

Example:

- Piezo-electric ignition
- Combustion engine with ignition
- Petrol-driven lawnmower
- Pneumatic tools
- Gas cooker with electric clock
- Teddy bear with battery

1.2.4 Article 3 (a)

Equipment which is "designed for use with a voltage rating not exceeding 1,000 volts for alternating current and 1,500 volts for direct current."

Example:

- Piezo-electric ignition (> 1500 V)
- High-voltage switchgear

1.2.5 Article 4 (1)
"Member States shall ensure that, from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), or polybrominated diphenyl ethers (PBDE). National measures restricting or prohibiting the use of these substances in electrical and electronic equipment which were adopted in line with Community legislation before the adoption of this Directive may be maintained until 1 July 2006."

It is understood that the substance ban refers to the final product and not the production process.

Note:

- The directive does not apply to the applications listed in the Annex.
- The directive does not apply to spare parts for the repair, or reuse, of electrical and electronic equipment put on the market before 1 July 2006 (Article 2(3)). This is to allow old equipment to be maintained with spare parts and to ensure that old electrical and electronic equipment is reused (that is, equipment put on the market before 1 July 2006).

1.2.6 Compliance (UK government, 2007)
Producers must demonstrate compliance with the RoHS regulations by providing the enforcement authority (upon request) with satisfactory evidence of such compliance in the form of relevant technical documentation or information. The 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. 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 supplier's materials declarations and part/materials analysis could play.

1.2.7 Supplier's materials declaration (UK government, 2007)
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 4 years after the particular EEE product was put on the market.

1.2.8 Materials analysis (UK government, 2007)
Producers may undertake (or ask a third party to undertake) their own analysis of the parts or materials they use in their products. This action may be undertaken either to verify supplier's materials declarations or to establish the presence or absence of the restricted substances in those cases where no declaration is available. Producers or third parties may employ any suitable analytical technique, preferably in line with international standards (e.g., IEC 62321, 2007), in order to establish that their products comply with the maximum concentration values of the six RoHS-regulated 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.

1.2.9 Enforcement (UK government, 2007)
Various powers of enforcement are available, including:

- Making test purchases;
- Requesting compliance documentation, inspecting processes, and performing analytical tests; and,
- Issuing a compliance notice requiring certain action to be taken.

1.3 ASSESSING PRODUCTS TO CHECK FOR INCLUSION WITHIN THE SCOPE OF RoHS REGULATIONS

To check whether a product falls under the RoHS regulations is the task of final makers who put their products on the EU market. Most of these makers are not SMEs; however, some SMEs can be the final makers.

Oftentimes, this checking responsibility is obvious; however, there are areas where uncertainties may exist, in particular products for which applications are not exclusively for the EEE. (Source: Directive 2006/66/EC, 6 September 2006). Figure 1-1 presents a flowchart for checking whether a product is within the scope of RoHS regulations.

In the flowchart, if your product falls within the categories 1 to 7 and 10 as set out in Annex I and/or consists of electric light bulbs or luminaries for domestic households, then you need to check whether your product is included in exemptions for which the RoHS Directive does not apply (Annex II). If your product is not in the product list in Annex II, then you need to check whether your product is in the grey area where uncertainties exist and thus the RoHS regulations do not apply (Annex III). If your product is not in the list in Annex III, as the last step check whether your product is in the list of Annex IV where specific applications of lead, mercury, cadmium, hexavalent chromium, and PBDE in the parts and products are exempt from RoHS regulations. If this is not the case, then you have to comply with the RoHS regulations.

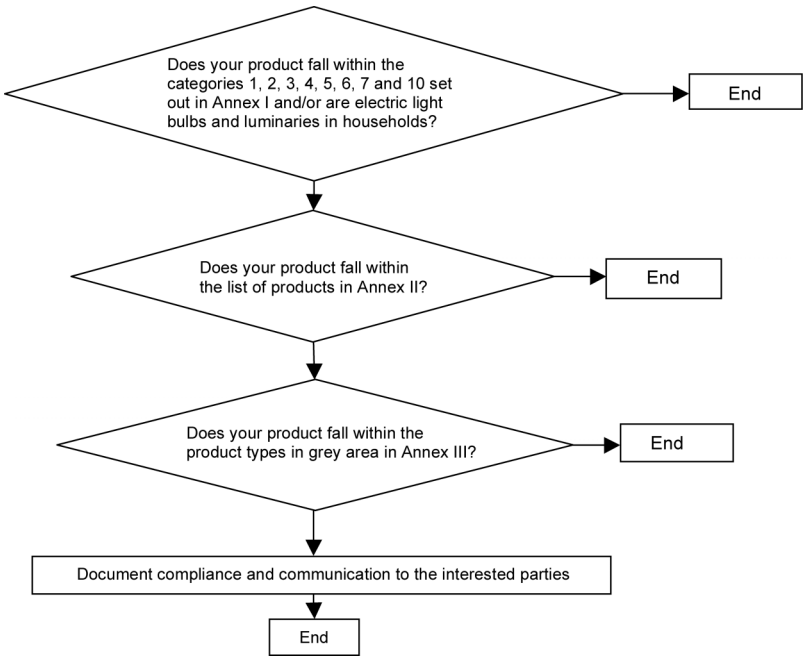


Figure 1-1 Flowchart to check whether product is within scope of RoHS regulations

ANNEX I

Product Types and List of Products Belonging to Product Categories

There are eight product categories of electrical and electronic equipment that are subject to RoHS regulations. In the WEEE regulations, a total of 10 product categories have been classified. Of these 10, categories No. 8 and 9 are not regulated under the RoHS regulations. However, these two product categories may well be covered in the future by new RoHS regulation currently under discussion in the EU. Below, the eight product categories with typical product types are shown. (2002/96/EC WEEE Directive, 2003)

1. Large Household Appliances

- Large cooling appliances
- Refrigerators
- Freezers
- Other large appliances used for refrigeration, preservation, and storage of food
- Washing machines
- Clothes dryers
- Dishwashing machines
- Cooking equipment
- Electric stoves
- Electric hot plates
- Microwaves
- Other large appliances used for cooking and food processing
- Electric heating appliances
- Electric radiators
- Other large appliances for heating rooms, beds, seating furniture
- Electric fans
- Air conditioners
- Other fan, ventilation, and air conditioning equipment

2. Small Household Appliances

- Vacuum cleaners
- Carpet sweepers
- Other appliances for cleaning
- Appliances used for sewing, knitting, weaving and other processing of textiles
- Electric irons and other appliances for ironing 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
- Clocks, watches, and equipment used for measuring, indicating, or registering time
- Scales

3. IT and Telecommunications Equipment
Centralized Data Processing:

- Mainframes
- Minicomputers
- Printer units

Personal Computing:

- Personal computers (including CPU, mouse, screen, and keyboar)
- Laptop computers (including CPU, mouse, screen, and keyboard)
- Notebook computers
- Notepad computers
- Printers
- Copying equipment
- Electric 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
- Facsimiles
- Telex
- Telephones
- Pay telephones
- Cordless telephones
- Cellular telephones
- Answering systems
- Other products or equipment for transmitting sound, images, or other information by telecommunications

4. Consumer Equipment

- Radios
- Televisions
- Video cameras
- Video recorders
- Audio systems
- 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 images other than by telecommunications

5. Lighting Equipment

- Luminaries for fluorescent lamps with the exception of luminaries in domestic households
- Straight (tube) 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

6. Electric 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 riveting, nailing, screwing, or removing rivets, nails, screws, or similar fasteners
- Tools for welding, soldering, or similar use
- Equipment for spraying, spreading, dispersing, or other treatment of liquid or gaseous substances
- Tools for mowing, trimming, edging, or other gardening activities

7. Toys and Leisure/Sports Equipment

- Electric toy trains, car racing sets
- Hand-held video game consoles
- Video games
- Computers for biking, diving, running, and rowing
- Sports equipment with electric or electronic components
- Slot machines

8. Automatic Dispensers and Vending Machines/ATMs

- 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 that deliver automatically any kind of products

ANNEX II

The following are exemptions for which the RoHS Directive does not apply:

- Large-scale stationary industrial tools. (This refers to 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.)
- 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.
- The reuse of EEE that was placed on the EU market before 1 July 2006.

ANNEX III

The following are product types in "grey areas" where uncertainties exist so that the RoHS regulations do not apply:

- EEE intended to protect national security and/or for military purposes
  - Equipment connected with the protection of the essential security interests of EU member states and to arms, munitions and war materials 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 also used to protect national security and/or has a military purpose, but is not designed exclusively for these purposes.
- 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 RoHS regulations extends only to those products that are dependent on electric current or electromagnetic fields to work properly, meaning that it is the primary power source. When the electric current is switched off, the product cannot fulfill 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.

  Example:
  The internal combustion engine would be considered to be outside the scope.
- Products where the electrical or electronic components are not needed to fulfill the primary function
  - This is related to, but not always the same, as the above situation. Some 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.

  Example:

  Musical greetings cards or soft toys with electronic components, which still fulfill their primary function without their electronic components and could be considered to be outside the scope.
- 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 RoHS is defined in identical terms as such exclusion extends to EEE under the RoHS regulations.

  Example:

  Lighting or entertainment equipment for use in vehicles, trains, or aircraft would be excluded as it is designed to be part of a product that falls outside the scope of the RoHS 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 is 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 regulations.

- Batteries
  - The RoHS regulation does not apply to batteries. This includes batteries that are permanently fixed inside the product, as well as removable, disposable batteries.

ANNEX IV

The following are exemptions of specific applications of lead, mercury, cadmium, hexavalent chromium and brominated flame retardants (PBDE) in the parts and products from the RoHS requirements:

Mercury

- Mercury in compact fluorescent lamps not exceeding 5 mg per lamp
- 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
- Mercury in straight fluorescent lamps for special purposes
- Mercury in other lamps not specifically mentioned in this Annex

Lead (Pb)

- Lead in glass of cathode ray tubes, electronic components, and fluorescent tubes:
  - Allowed to use Pb in CRTs, electronic parts, and fluorescent lamps
  - Pb in the CRT glass plays a key role in adsorbing X-rays
  - Pb is used for sealing between glass and metals in lamps and LCD
  - It is also used as a septum in the PDP to form a space for plasma generation. In particular, Pb contained in the glass used for the manufacturing of the under coat and over coat of a chip part results in high concentration of Pb if an analysis is made for a sample prepared by mixing. In order to determine whether the exemption applies, Pb content per homogeneous samples should be checked.

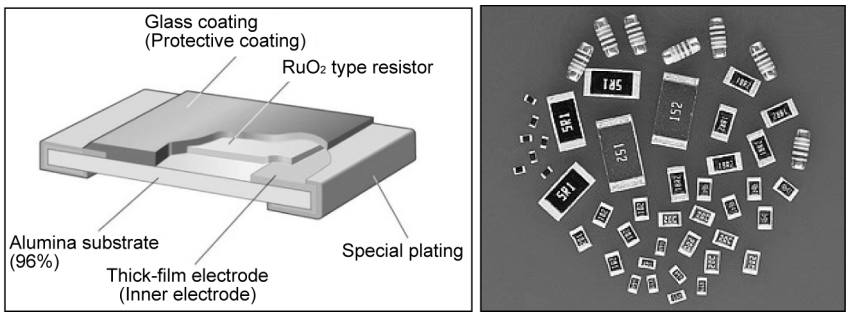


Figure 1-2 Image of parts in exemption No. 5 clause

Source: http://www.sem.samsung.co.kr/cms/ifweb/kr/products/productOverview.jsp?pcode=A070&pname=Chip%20Resistors&loca=a&navi=overview&tmp02=app

http://www.globalspec.com/FeaturedProducts/Detail/Venkel/Thin_Film_Chip_Resistor_Kits/48967/0

- Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminum containing up to 0.4% lead by weight, and as a copper alloy containing up to 4% lead by weight
  - Pb-containing materials are used to enhance cutting and processing.
    For instance, Pb content of steel SUM22L/23L/24L/31L, aluminum A2011, and brass C3601/3604 are 0.1~0.35%, 0.2~0.6%, and 1.8~3.7%, respectively.
  - Currently Pb-free steel and brass are available; however, they are quite expensive compared to conventional materials.

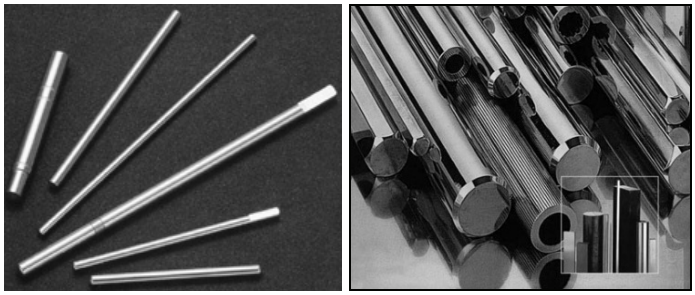


Figure 1-3 Image of parts in exemption No. 6 clause

Source: http://www.meiton.com.hk/cgi-bin/product.cgi?action=product&language=&sortby=&menu=&part=1&page=1&,

http://www.goldenharbour.com/StockList/NonFerrousMetalsAlloySteel.htm

- Lead in high melting temperature-type solders (i.e., lead-based alloys containing 85% by weight or more Pb)
  - Composition of the lowest melting point of conventional solder (Sn63%Pb37%) cannot be used for certain parts (e.g., chip-type parts). In this case, high melting point solder has to be used in order to avoid electrical conductivity and reliability problems. Thus the use of existing solder with a high melting point is exempted.

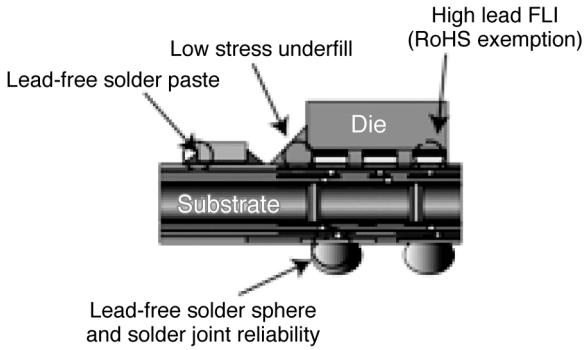


Figure 1-4 Image of flip chip package using high melting point solder

Source: http://www.future-fab.com/documents.asp?d_ID=3044

- Lead in solders for servers, storage, and storage array systems, network infrastructure equipment for switching, signaling, and transmission as well as network management for telecommunications
- Lead in electronic ceramic parts (e.g., piezo-electric devices)
  - Ceramic materials are an essential ingredient for electronic parts such as capacitors, resistors, piezo-electric devices, PTC devices, magnets, and circuits of IC chips. The ceramic materials are indispensable for maintaining the function of these electronic parts.

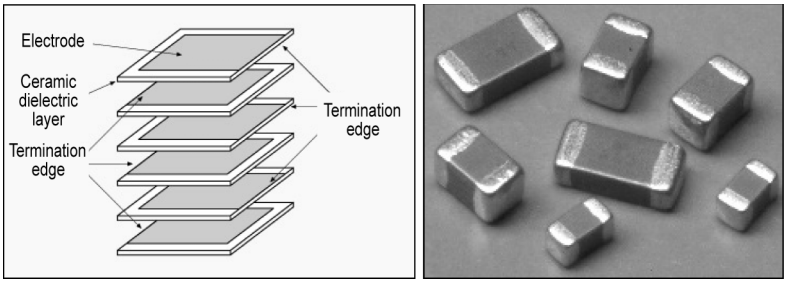


Figure 1-5 Image of parts in exemption No. 7 clause

Source: http://www.ami.ac.uk/courses/topics/0135_cc/index.html, http://news.thomasnet.com/fullstory/13303,

Cadmium

- Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC and amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations
  - Materials for the electrical contact are used for the contact point for opening and closing the electrical circuit of the switches and relays. During the operation of the electrical devices, cadmium vapors are generated because of arc heat.
  - Parts for the electrical contact require high reliability and safety. Thus, contact resistance of the part against surface resistance should be low. In this respect, AgCdO is widely used because of its high reliability.
  - Currently Ag-Ni, Cu-Ni, and Ag-SnO2 are used as substitutes for AgCdO.

Lead and Cadmium

- Lead and cadmium in printing inks for the application of enamels on borosilicate glass
- Lead and cadmium in optical and filter glass

Hexavalent Chromium

- Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators
- Hexavalent chromium in corrosive preventive coatings of unpainted metal sheets and fasteners used for corrosion protection and electromagnetic interface shielding in equipment falling under category 3 of Directive 2002/96/EC (IT and telecommunications equipment) (Exemption granted until 1 July 2007)

Brominated Flame Retardant (PBDE)

- Deca-BDE in polymeric applications; this applies only to Deca-BDE, not to any other type (e.g., Nona-BDE)
  - In general, polymeric applications of flame retardants, PBDEs, are RoHS-regulated substances; however, Deca-BDE, which is one type of PBDE, is exempt from the regulated substance list because it has not been proved to be hazardous.
  - When material contains Deca-BDE, it is probable to contain Octa-BDE and Nona-BDE, which have been banned substances for most producers. Along this line, major producers in Republic of Korea banned the use of Deca-BDE in electronics parts.

Lead (Pb)

- Lead in lead-bronze bearing shells and bushes
- Lead used in compliant pin connector systems
- Lead as a coating material for thermal conduction module c-rings
- 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
- Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages
- Lead in linear incandescent lamps with silicate-coated tubes
- Lead halide as the radiant agent in high density discharge (HDD) lamps used for professional reprography applications
- Lead as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as tanning lamps containing phosphors such as BSP (BaSi2O5:Pb) as well as when used as specialty lamps for diazo-printing reprography, lithography, insect traps, and photochemical and curing processes containing phosphors such as SMS ((Sr,Ba)2MgSi2O7:Pb)
- Lead with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact energy-saving lamps (ESL)
- Lead oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for liquid crystal displays (LCD)
- Lead as an impurity in RIG (rare-earth iron garnet) Faraday rotators used for fiber optic communications systems
- Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead-frames
- Lead in solders for soldering through hole discoidal and planar array ceramic multilayer capacitors
- Lead oxide in plasma display panels (PDP) and surface conduction electron emitter displays (SED) used in structural elements; notably in front and rear glass dielectric

layer, bus electrode, black stripe, address electrode, barrier ribs, frit seal, and frit ring, as well as in print pastes

- Lead oxide in the glass envelope of black light blue (BLB) lamps
- 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
- Lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3, and 4) of Council Directive 69/493/EEC

The following three new exemptions were adopted by TAC on 3 October 2007.

- Cadmium alloy as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-power loudspeakers with sound pressure of 100dB (A) or more
- Lead in soldering materials in mercury-free flat fluorescent lamps (e.g., used for liquid crystal displays, signs, or industrial lighting)
- Lead oxide in frit seal used for making window assemblies for argon and krypton laser tubes

2. UNDERSTANDING THE PRODUCER'S SUPPLIER CONTROL PROCESS

Most SMEs are suppliers to customers along the supply chain, notably electronic part assembly (Ass'y) makers and final set (component) makers (referred to here as "producers" to be in alignment with the term used in the RoHS Directive which includes such producers as Ass'y makers and final set makers). The producers place their products on the EU market so that direct responsibility for complying with the RoHS Directive lies with them. Since products are made of various parts, those suppliers supplying parts to the producers have to comply with the requirements of the RoHS Directive.

It is noteworthy to observe the trends of the customers (producers) requesting hazardous substance information in the parts they acquire from their suppliers. This was triggered by the RoHS Directive. Table 2-1 shows how the electronics industries have progressed from basic information needs for specific process chemicals to information on a wide spectrum of hazardous substances in the entire product.

Table 2-1 Trends on customer requests for hazardous substance information on supplied parts

Phase	Period	Scope	Nature of request
I	1995–1999	Cleaning agents used in unit processes	Use of ozone layer-depleting substances
II	2000–2001	Restricted-use substances in the products	Information on regulated heavy metals and others
III	2002	Type and content of major materials and substances in processes and products (including certificate)	Indication whether regulated substances are used
IV	2003–present	Type and content of all materials and substances in processes and products (including certificate)	Information disclosure on composition of entire product – mass basis/application/ composition

Together with the shift in information needs of the producers on the hazardous substances in their supplied parts, hence in their products, the depth of information also increased. Table 2-2 shows the types of information requested by producers specific to the hazardous substances control for supplied parts. The information needs encompass from the environmental management system to product-specific attributes on hazardous substances such as the reliability of lead-free soldering.

Table 2-2 Specific information on hazardous substances requested by producers from suppliers

Information type	Information specific to hazardous substance control
EMS certificate	• Meeting the criteria set by the buyer on RoHS-regulated and other hazardous substances controlled by the producer • Prerequisite to green supply chain management certification
Non-use certificate	• Declaration that supplied parts do not contain RoHS-regulated and other hazardous substances • Proof that regulated substances are not present in materials used for supplied parts
Raw material composition	• Preparation in accordance with materials declaration form submitted by producer • Necessary to trace hazardous substances in materials in case of non-compliance
Analysis results of hazardous substances	• Proof that maximum concentration values were met by supplied parts • Preparation in accordance with form by buyer • Certificate issued by certified laboratory • Expiration period: 2 years

Therefore, understanding the producers' management practice on the RoHS-regulated substances and the parts containing them, in particular their immediate customers and/or final set makers, is the first consideration for SMEs to achieve RoHS compliance. They must then respond to the demands by the producer on RoHS compliance in accordance with their instructions. The first is the most important step for SMEs as such complete understanding will lead to successful RoHS compliance in the next step, provided that SMEs follow faithfully the instructions given in the first step. Thus, emphasis will be placed on step No. 1 in this manual. Chapter 2 focuses on the first part of the first step. The second part is dealt with in Chapter 3.

The first requirement described in Chapter 2 is to gain an understanding of the producer's supplier control process. This has two sections: parts control flow related to RoHS-regulated substances (2.1) and the green supplier certification system (2.2). The second requirement, which is the topic of Chapter 3, is about how a supplier can set up its own parts control process. It also has two sections: identifying the raw material composition of a part (3.1) and generating analytical data for RoHS-regulated substances of the part (3.2).

Chapter 2 should be read with special care by SMEs, for the supplier control process implemented by the producer is applied without exception to all SMEs along the supply chain. The supplier control process consists of parts control flow related to RoHS-regulated substances and green supplier certification (the hazardous substance management system certification). The former is controlled by checking for the presence of hazardous substances is controlled during the new parts approval process and parts inspection process, while the latter by certifying the supplier as a partner in the producer's green supply chain management system (e.g., the "Green Partner Program" of Sony, "Eco-partner Program" of Samsung, etc.).

2.1 PARTS CONTROL FLOW FOR ROHS-REGULATED SUBSTANCES

2.1.1 Producer's parts control flow

Figure 2-1 shows one process for the approval of parts in the production of final products. The presence of hazardous substances in newly developed parts and mass-produced parts is checked through a screening test conducted by the producer. The screening test in this instance is carried out by XRF (X-ray fluorescence).

Table 2-3 shows RoHS-regulated substances (Class I) with the major parts using them, and their application. The hazardous substances are not limited to those regulated under the RoHS Directive; most producers also ask for information about Class II substances as shown in Table 2-4.

Table 2-3 Application of RoHS-regulated substances (Class I)

Substance	Major parts	Application
Pb	Lead soldering, lead battery, rubber, plastics, glass, CRT, ceramic condenser, electrode, etc.	Rubber solidifier, coloring agent, paint, lubricant, plasticizer, battery material, etc.
Cd	Electrical contact, Ni-Cd battery, plating, PVC coating of power cables, etc.	Coloring agent, rust-proof treatment, stabilizer, plating material, etc.
Hg	Electrode, mercury battery, battery, lamp, fluorescent tube, LCD backlight, etc.	Rust-proofing agent, high efficiency light-emitting device, coloring agent, electrical contact materials, etc.
Cr+6	Chromate steel plating, battery, color filter, rust-proof chromate treatment, etc.	Coloring agent, paint, ink, catalyst, plating, rust-proofing treatment, etc.
PBBs, PBDEs	PCB, power cable coating, connector, switch, fuse, switch board, etc.	Flame retardant

Table 2-4 List of substances with environmental impacts (Class II)

Polychlorinated biphenyls (PCBs) Polychlorinated terphenyls (PCTs) Polychlorinated naphthalences (PCNs)	Azo colorants
Ozone-depleting substances (CFCs, HCFCs, Halon)	Nickel and compounds
Asbestos and asbestos compounds	Organic tin compounds
Formaldehyde	Arsenic and compounds
Short-chain chlorinated paraffin (Alkane 10~13 carbon chain)	

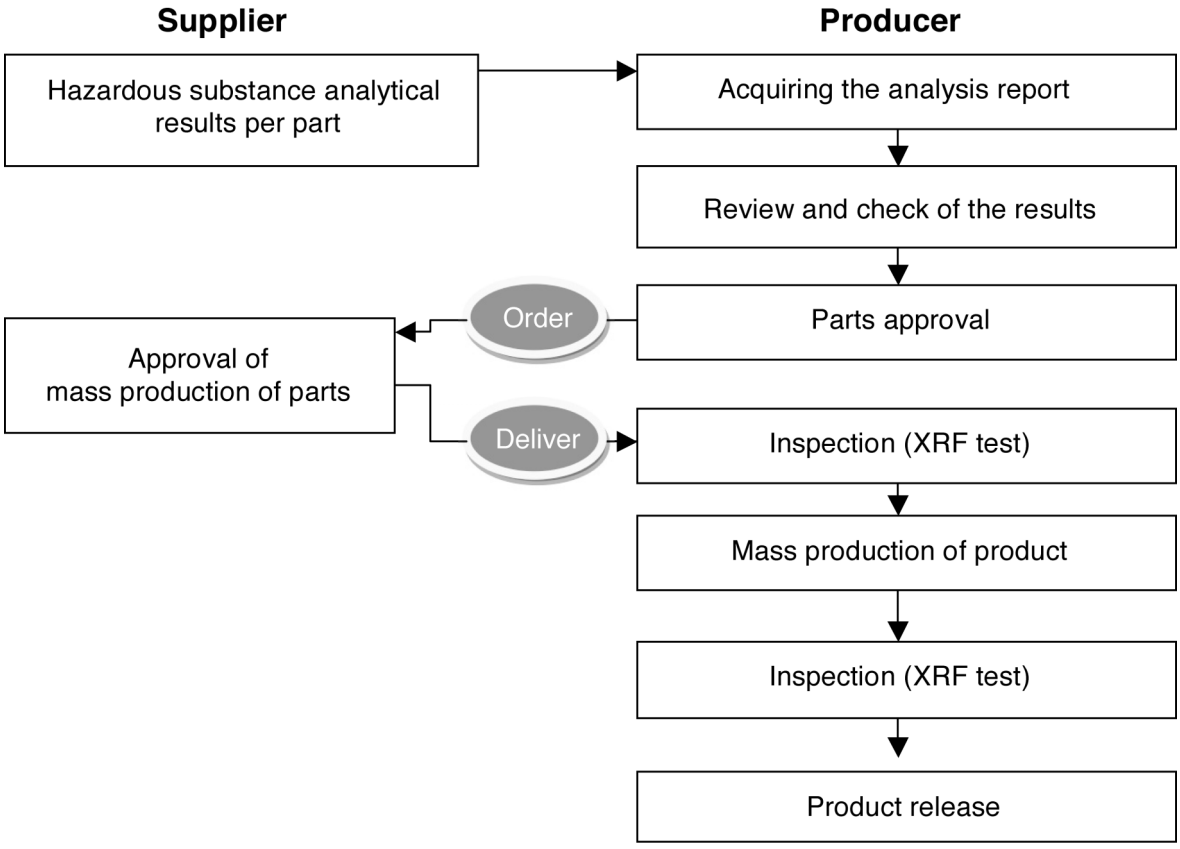


Figure 2-1 Process for parts approval in production of final product

Source: http://www.sec.co.kr/

Table 2-5 shows criteria for allowable concentrations of RoHS-regulated (Class I) substances in parts. The concentration limits are less than those stipulated in the RoHS Directive. This is a normal practice for producers to ensure a margin of safety in controlling hazardous substances in their products. All data related to the control of hazardous substances are managed in the form of a database accessible over the Internet.

Table 2-5 Approval criteria for amounts of RoHS-regulated (Class I) substances in parts as set by producers (unit: ppm)

Material	**Pb**	**Cd**	**Hg**	**Cr+6**	**Brominated flame retardants**
Polymers	100	5	800	800	800
Metals	800	5	800	800	N/A

Source: http://www.sec.co.kr/

2.1.2 Parts approval process

Parts under development for use in the final product must undergo verification as to the presence of hazardous substances.

1) Approval process for newly developed parts

Figure 2-2 shows one process for the approval of parts newly developed by the producer and made by the supplier. In order to ensure that the supplier is qualified to meet the RoHS requirements, a supplier must first meet requirements of the green supply certification system and be certified as a "green partner." Samsung Electronics' Eco-partner program is given below as an example. As can be seen in Figure 2-2, in-depth analysis data of the parts submitted by the supplier are reviewed by the producer and corrective measures are taken as appropriate.

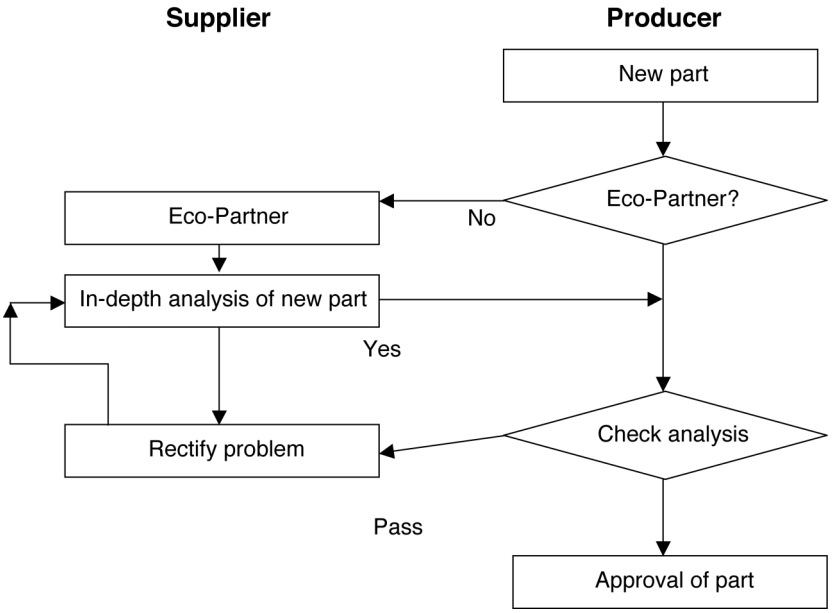


Figure 2-2 Process for approval of parts newly developed by a producer

Source: http://www.sec.co.kr

2) Documents submitted by suppliers to obtain approval of parts

Suppliers must submit relevant documents and related samples to the producer if new parts are to be supplied for the first time. The reason is that the producer needs to evaluate whether the hazardous substance management system of the supplier conforms to that of the producer.

The required documents and samples accompanied by the new parts are:

- Analytical data of hazardous substance
- Material composition
- Samples for approval

In general, the number of samples to be submitted should be more than five and the amount of the sample has to be contained within a 2-cm circle.

3) Approval of new parts
The producer checks the analytical data and material composition of the parts submitted by the supplier. The next step is to verify the submitted sample by performing an in-depth analysis such as ICP (inductively coupled plasma spectroscopy). If a supplier is new to the producer, the supplier has to go through the producer's green supply certification process and became certified. If all results meet the producer's criteria, the new parts are approved.

2.1.3 Parts inspection process

All parts entering into the product assembly line undergo verification as to the presence of RoHS-regulated substances. Figure 2-3 shows the part inspection process. In the event that a failure of a particular part occurs in the inspection process, the cause of the failure is sought and corrective measures are taken. The corrective measures can include cancellation of the green supply certification, and stopping the procurement of the part from the supplier until the cause of the failure is rectified. The frequency of the parts inspection varies depending on the "risk level" of the part. Table 2-6 shows the inspection frequency and inspection frequency of particular parts in accordance with the defined level of risk of the part.

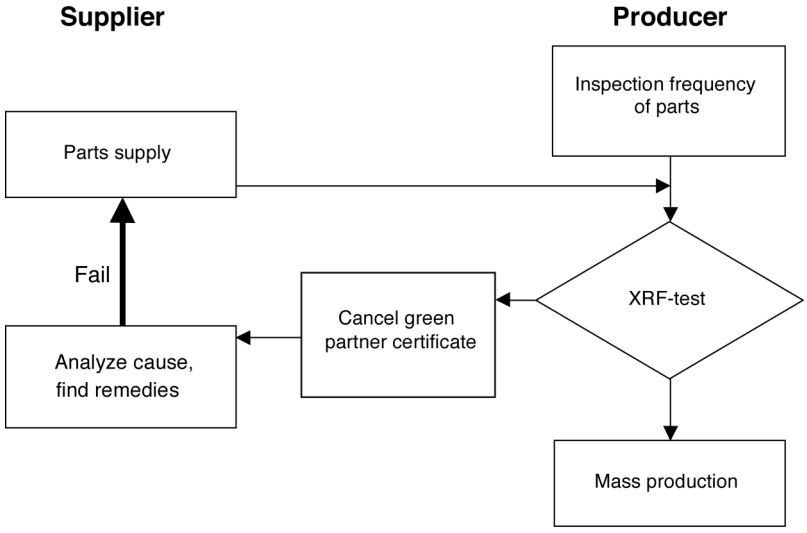


Figure 2-3 Parts inspection process

Source: http://www.sec.co.kr

Table 2-6 Parts inspection frequency

Risk level	Applicable parts	Frequency
I	• Seven parts groups of high risk (extrusion, painting, plating, power cord, rubber, wire, plating) • Parts with a history of violations of RoHS-regulated substance control limits	Once/week
II	• All parts excluding risk level I parts	Once/month

2.1.4 Final product inspection process

There are two types of final product inspections: general inspection and disassembly inspection. For the general inspection, a portable XRF is used to check for the presence of RoHS-regulated substances without disassembling the final product. Alternatively, disassembly inspection uses a desktop XRF to check for the RoHS substances after the product is disassembled.

2.2 GREEN SUPPLIER CERTIFICATION SYSTEM

Most major producers operate a green supply management system, and every supplier is required to be certified to become a green partner. To be certified as a green partner, the supplier must meet the producer's RoHS substance control criteria for parts and materials in the parts, and a management system enabling the control of hazardous substance should be in operation. Suppliers include parts suppliers, packaging suppliers, raw material suppliers, and original equipment makers.

2.2.1 Certification procedure

As part of the certification procedure, the supplier submits information on the raw material composition of the part, a list of hazardous substances and materials under its control, analytical data (if a part contains RoHS-regulated substances), and declaration of non-use of RoHS-regulated substances and warranty of RoHS compliance. (Descriptions on these requirements are given in Chapter 3). In addition, a supplier must pass an on-site audit of the hazardous substance management system administered by the producer's auditor. Figure 2-4 shows the certification procedure of a company in Republic of Korea.

The certificate is renewed every two years for most suppliers. However, certificates of suppliers supplying RoHS-regulated substances are renewed every year because of the potential risk of non-compliance.

2.2.2 Audit of supplier's hazardous substance management system

The auditors from the producer's quality, environmental, and/or purchasing department conduct on-site visits of the suppliers to assess the hazardous substance management system. The system includes the environmental management system (EMS) and the materials and parts control systems. This is because the latter two systems provide the basic foundation for successful control of hazardous substances that may be present in the materials, parts, and processes used on the supplier's premises.

The assessment items and weighted score of each item are listed in Table 2-7. Each item is assessed according to three levels: good, average, and poor.

The score in Table 2-7 is given as an example and varies depending on the individual company. Nonetheless, the scoring approach is more or less common in most electronics companies. A passing score, in general, is 80 points out of 100. However, the compulsory items shown in brackets [ ] in Table 2-7 must score more than 42 out of 50 points. If not, the supplier fails to pass the audit and the green supplier certificate is denied.

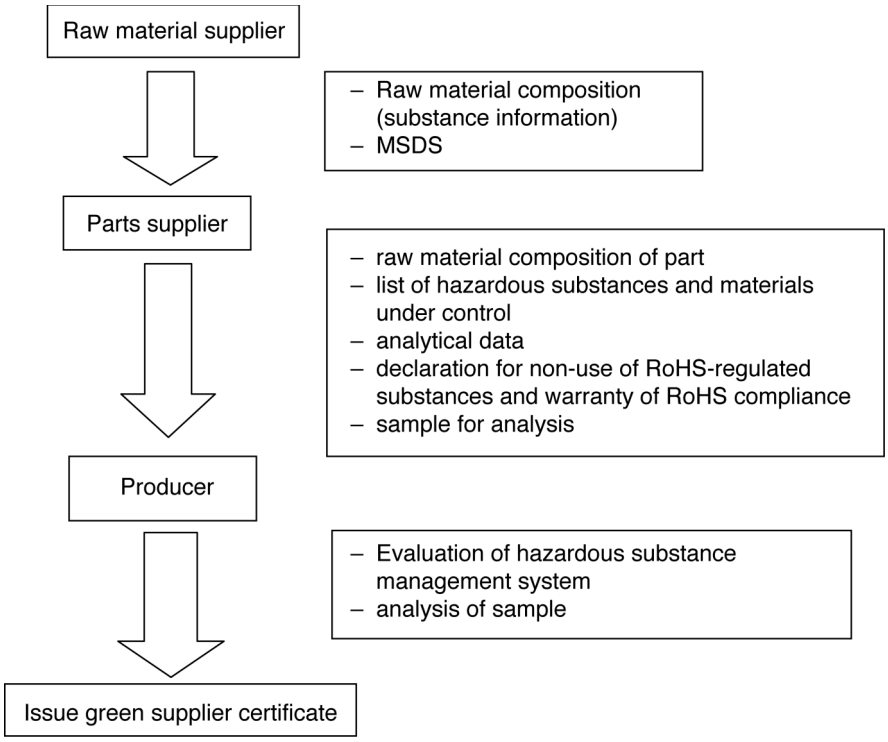


Figure 2-4 Green supplier certification procedure

Source: http://www.sec.co.kr

Table 2-7 Assessment items and scores for assessment of hazardous substance management system

Assessment item		
Major category	**Sub-category**	**Score [ ]***
Environmental Management System (EMS); presumed to meet the EMS requirements if certified by ISO 14001 (30)	Policy and strategy	10 [4]
	Internal audit	10 [4]
	Training	5
	Information sharing	5 [2]
Hazardous substance management system (including RoHS substances] (40)	Improvement plan	11 [8]
	Control of non-conforming parts	11 [5]
	Control of changes in parts	8 [7]
	Control of its suppliers	10 [5]
Materials and parts control	Incoming parts inspection	12 [6]
	Material and process control	7 [3]
	Outgoing parts control	11 [6]
Total		100 [50]

Upon successful completion of the audit, the supplier is awarded the green supplier certificate. Examples of the certificates can be found in Section 4.1.

3. HOW A SUPPLIER CAN SET UP ITS OWN PARTS CONTROL PROCESS

A supplier can set up its own parts control process in order to meet the special requirements of the producer. These requirements have already been identified and their particulars are described in Chapter 2. Thus setting up a parts control process means that the supplier establishes a process to identify the composition of the raw materials of parts and generate detailed analytical data for RoHS-regulated (Class I) substances they may contain.

A parts control process is often termed a "hazardous (RoHS-regulated) substance management system." In general, a well-planned management system can ensure consistency within the on-going operations of such an oversight system. Thus, establishing a reliable hazardous substance management system and implementation of the system by the supplier in the manufacturing of parts are essential to meeting the producer's requirements as set out in Chapter 2.

Figure 3-1 shows a supplier's part control process. Below is a detailed description of each unit process shown.

A supplier may have to submit some or all of following documents to its customer-producer:

- Raw material composition data of part
- List of hazardous substances and materials to control
- Analytical data
- Improvement plan (if part exceeds producer's RoHS-regulated substances control limit)
- Declaration for non-use of RoHS-regulated substances
- Warranty of RoHS compliance

Analytical data on the hazardous substances of raw materials comprising a part are prepared at the interval requested by the producer. The interval is one year in most Korean electronics manufacturers. Note that this analytical data is per each type of raw material of a part. For instance, if a part consists of 10 materials, then there must be 10 separate analytical data reports generated. In order to carry out the analysis, a supplier should understand what the criteria are of the raw materials comprising a part and how a part is decomposed into materials. Based on this information, a supplier can set up a process to acquire detailed analytical data of the parts it supplied and report the data to the producer. Normally the process is certified by the producer (under the name of "Green Partner" in the case of Sony, and "Eco-Partner" in the case of Samsung Electronics (see Section 2.2)).

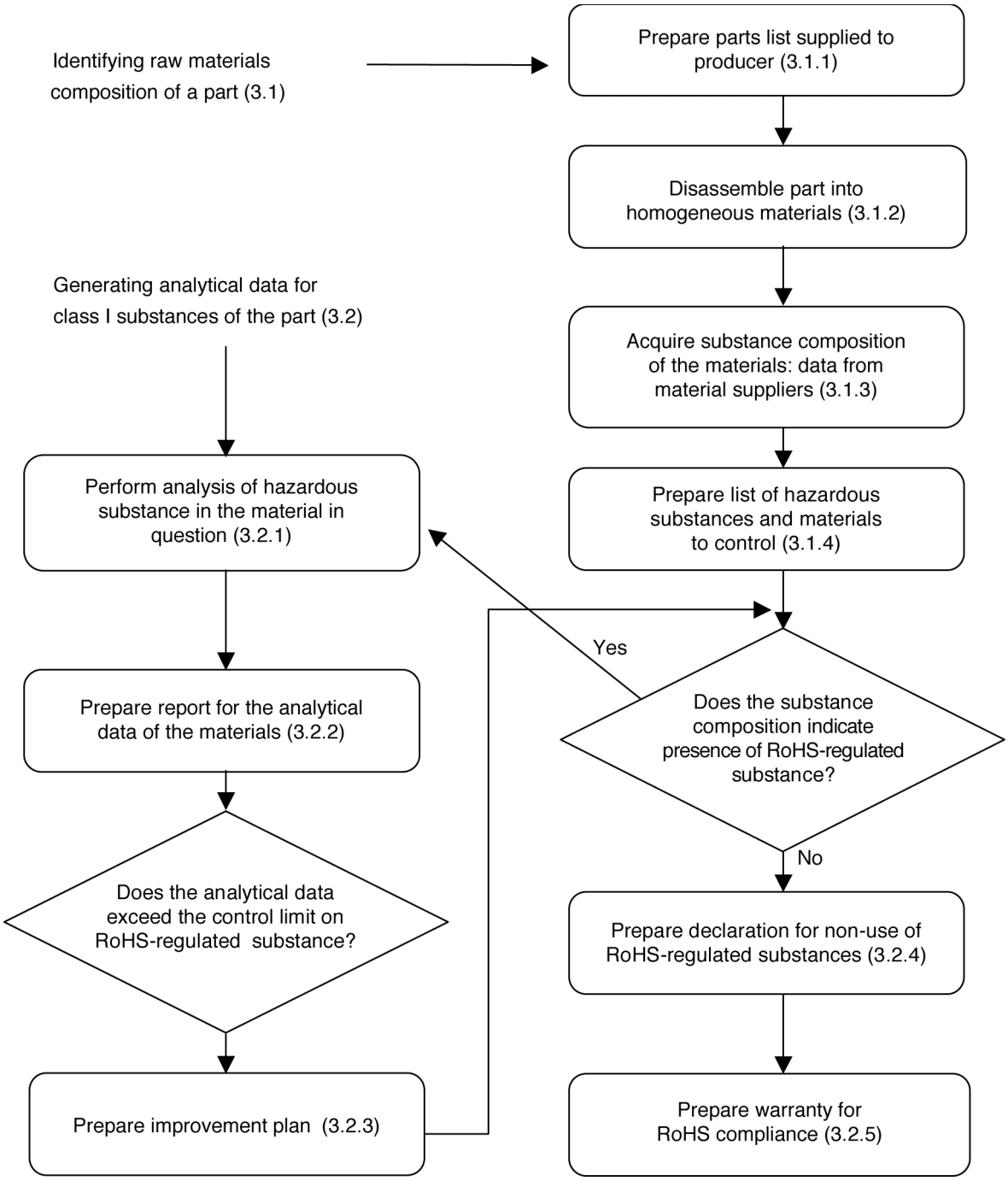


Figure 3-1 Supplier parts control process (hazardous substance management system)

3.1 IDENTIFYING THE RAW MATERIALS COMPOSITION OF A PART

At the time of the on-site audit of the suppliers' facility by the producer, the auditors check the raw material composition of the supplied part or parts. In order to meet the auditing requirements, a list of parts being supplied to a specific customer should first be prepared (3.1.1). Using the part list information, a part is disassembled into homogeneous materials to obtain samples for analysis (3.1.2). At the same time, the substance composition of the materials should be acquired from the material suppliers (3.1.3). Based on the substance composition data, a list of hazardous substances and materials to control can be prepared.

3.1.1 Preparation of parts list

The first thing a supplier should do is prepare a list showing parts supplied to a particular producer. The parts list provides basic information as to the control of hazardous substances in those parts. Preparing the list is the starting point for the operation of the supplier's part control process. Table 3-1 gives an example of a parts list.

Table 3-1 Example of parts list (supplied to a specific producer)

Part name	Part code*	Product name	Remarks
A	000-0000	MLCC	
B	111-1111	Chip resistor	
C	222-2222	Chip inductor	
…	….	…	

* The code used by the producer.

3.1.2 Disassembling a part into homogeneous materials

In order to acquire the required analytical data, the part must be disassembled. There are two types of parts, one consisting of materials only, and the other an assembly of various sub-parts and materials, often termed in the parts description as an "Assembly." Thus, an assembly is a part consisting of more than one sub-part (or lower-level parts), subassembly, and materials.

A criterion for defining the raw materials of a part in the RoHS Directive is the definition of homogeneous materials given in the directive and explained in Chapter 1: A homogeneous material is "of uniform composition throughout." Homogeneous materials are individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins, and coatings.

Thus any raw material belonging to this definition should be identified and analyzed for its content with respect to the hazardous substances as requested by the producer. Here RoHS-regulated substances are included if a part contains substances identified in Section 3.1.4.

Disassembly of a part consisting of materials only

Figure 3-2 is an example of a fictitious part consisting of materials only. This part contains seven raw materials requiring detailed analysis for the presence of hazardous substances. Table 3-2 shows a list of the raw materials in the part along with each suppliers's name. With this information, the supplier can trace its own suppliers (raw materials in this case) to acquire relevant information about the raw materials.

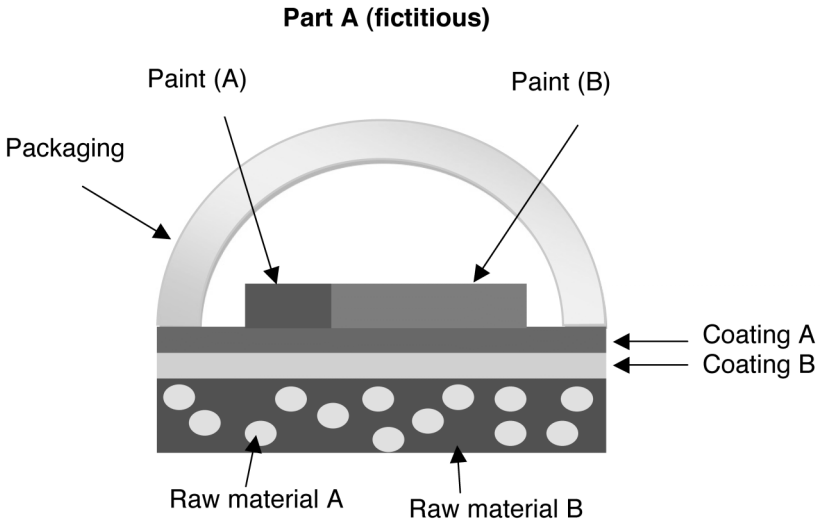


Figure 3-2 Example of fictitious "Part A" consisting of materials only

Source: Samsung Electronics CS Management Center, Eco-Partner Certificate Manual for RoHS, 2004

Table 3-2 List of manufacturers/suppliers of raw materials used in "Part A" shown in Figure 3-2

Part	Material name	Material supplier
Part A	Paint A	Z Co.
	Paint B	Y Co.
	Coating A	X Co.
	Coating B	W Co.
	Raw material A	V Co.
	Raw material B	U Co.
	Packaging	T Co.

Example: Disassembly of a part

In principle, all parts must be broken down into homogeneous materials. If a part cannot be broken down into its homogeneous materials, the part should be homogenized either by mixing after grinding or through chemical treatment. In the case of the condenser cited in the example of the disassembly of Part A above, the lead terminal and main body are separated in the first pass. Then the body is ground into various homogeneous materials in the second pass. However, this type of disassembly is time consuming and costly. (Because of this problem, parts smaller than $4mm^3$ are considered homogeneous materials in the Chinese RoHS regulations under the EIP-C category.)

Those products marked with an asterisk (*) in Figure 3-3 below contain parts difficult to disassemble using ordinary tools, and so require homogenization. If hazardous substances are shown as present by the screening test, a further detailed disassembly is necessary. They are disassembled in the sequence of the disassembly process.

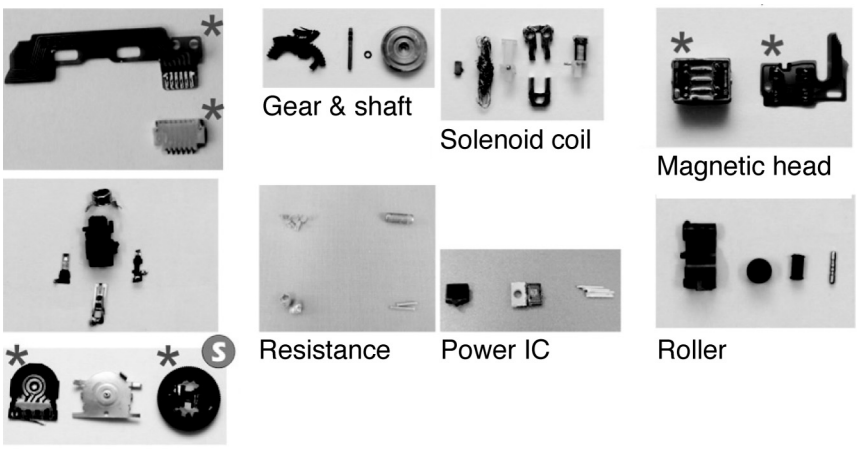


Figure 3-3 Example of disassembly of parts into homogeneous materials (KOECO, 2007)

Disassembly of assembly into materials

In order to generate analytical data for an assembly, the first thing to do is to develop a hierarchy between the assembly and all lower-level parts and/or lower-level assembly with materials of each sub-part and/or subassembly. Figure 3-4 is an example showing the hierarchy for an assembly. Table 3-3 lists the raw materials in the part along with each manufacturer's name.

If there are different manufacturers for the same raw material, analysis should be made for each manufacturer. This assumes that a different manufacturer may have a different level of quality control or may employ a different manufacturing process.

Table 3-3 List of manufacturers/suppliers of raw materials used in "Assembly A" shown in Figure 3-4

Part	Material name	Material manufacturer
Assembly A	Paint A	Z Co.
	Paint B	Y Co.
	Coating A	X Co.
	Raw material A	W Co.
	Raw material B	V Co.
	Packaging A	U Co.
	Packaging B	T Co.

In the case of Raw material A, Paint B, and Coating A in Figure 3-4, though they are used in different parts, only one analysis for each material and coating suffices because the manufacturer of each is the same.

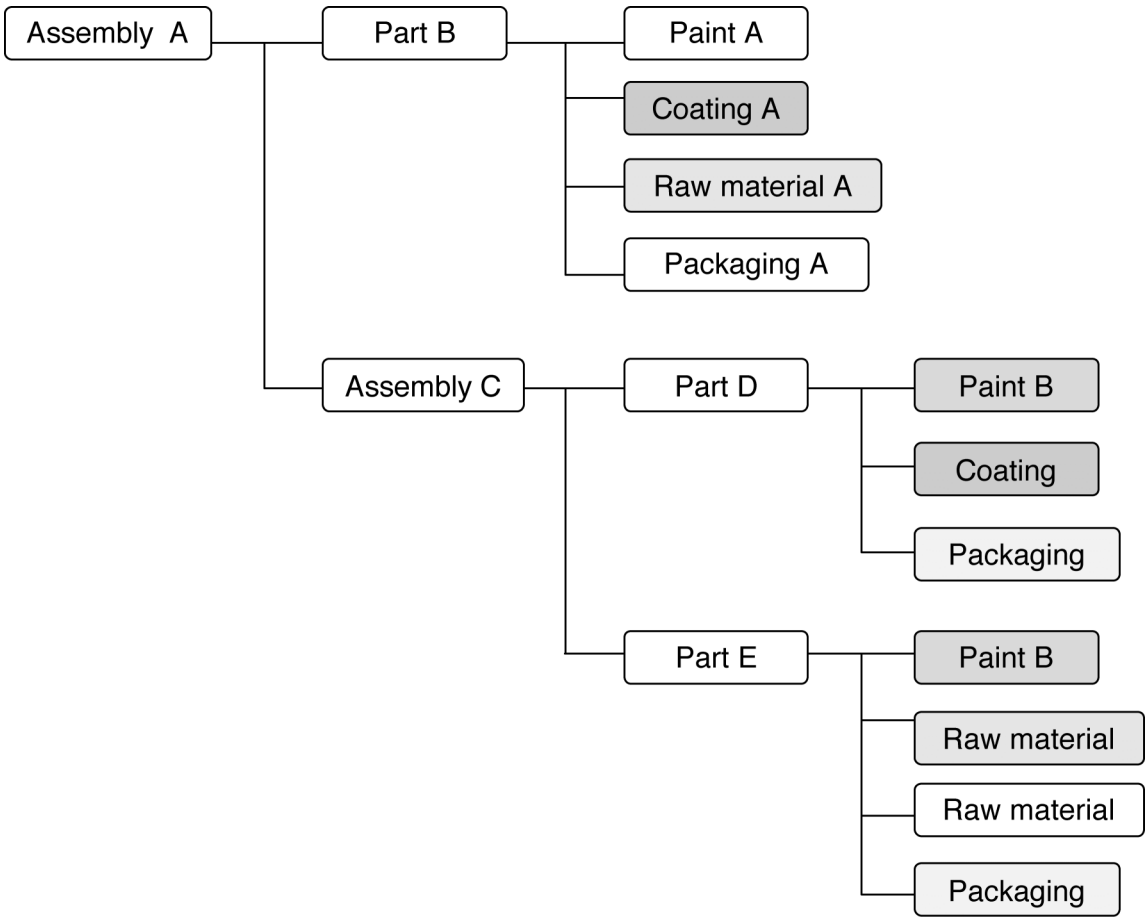


Figure 3-4 Example of fictitious "Assembly A"

Source: Samsung Electronics CS management center, Eco-Partner Certificate Manual for RoHS, 2004

Example: Disassembly of an assembly part – PCB Assembly

A PCB (printed circuit board) is disassembled into PCB board, connector, jack, and electronic parts. Some parts can be easily disassembled into homogeneous materials for analysis by simple cutting, snapping, and unscrewing; however, parts such as condensers, chips, and ICs need further disassembly. Those marked with * in Figure 3-5 on the next page are parts that are difficult to disassemble using ordinary tools, and they are further disasembled in the sequence of the disassembly process.

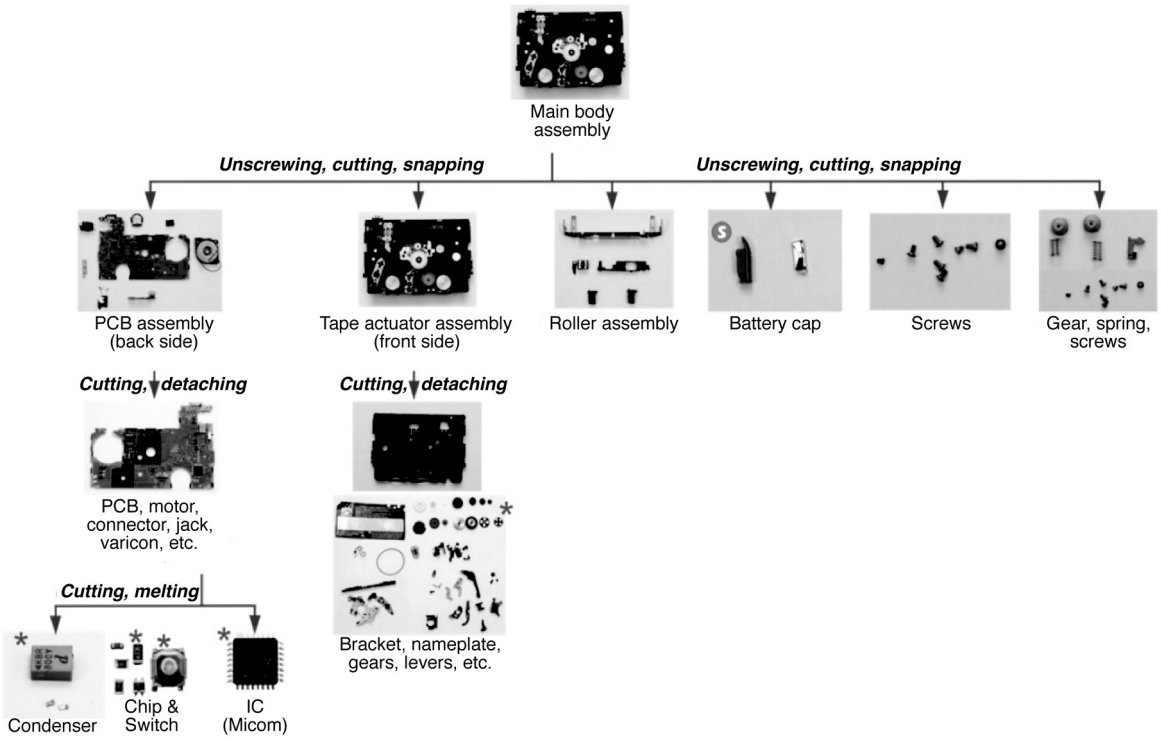


Figure 3-5 Example of disassembly into subparts and subassembly (KOECO, 2007)

Example: Disassembly of parts at Korean parts maker
Below is an example of the disassembly of a part at the Korean parts maker using ordinary tools.

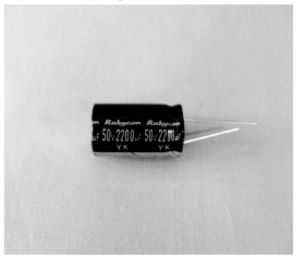
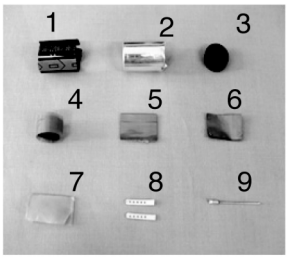
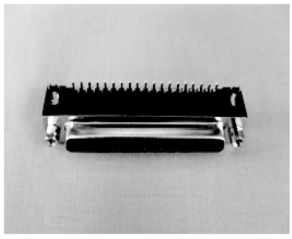
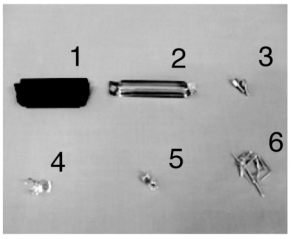
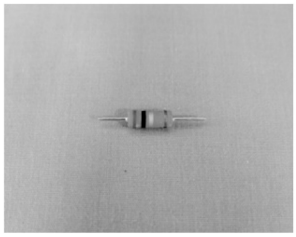
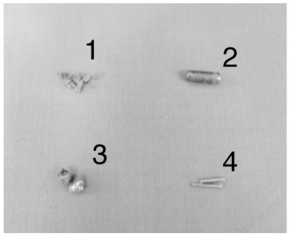
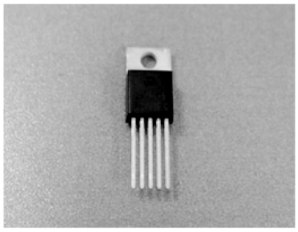
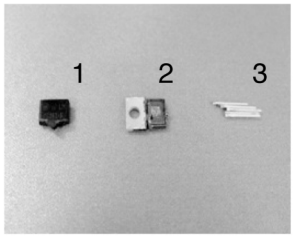
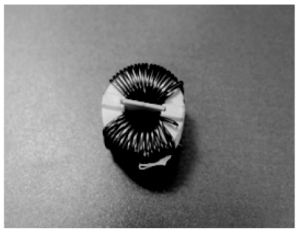
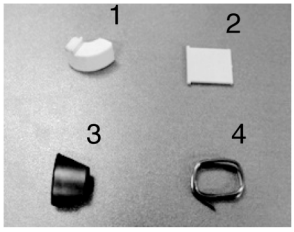
Part	Structure	Sample No.	Hazardous substance	Sampling method
Capacitor 		1	6 substances	Scraping
		2	4 heavy metals	Scraping
		3	6 substances	Scraping
		4	6 substances	Scraping
		5	4 heavy metals	Scraping
		6	4 heavy metals	Scraping
		7	6 substances	Scraping
		8	4 heavy metals	Cutting
		9	4 heavy metals	Cutting
D-SUB connector 		1	6 substances	Scraping
		2	4 heavy metals	Scraping
		3	4 heavy metals	Scraping
		4	4 heavy metals	Scraping
		5	4 heavy metals	Unscrewing
		6	4 heavy metals	Scraping
Resistance 		1	6 substances	Scraping
		2	6 substances	Scraping
		3	4 heavy metals	Scraping
		4	4 heavy metals	Cutting
Power IC 		1	6 substances	Scraping
		2	4 heavy metals	Scraping
		3	4 heavy metals	Cutting
Coil 		1	6 substances	Cutting
		2	6 substances	Cutting
		3	4 heavy metals	Cutting
		4	4 heavy metals	Cutting

Figure 3-6 Example of disassembled parts at a Korean parts maker (KOECO, 2007)

3.1.3 Acquiring substance composition of materials (data from suppliers)

Once you identify the material composition of a part together with the particulars of the material suppliers, you can ask for the composition of the material broken down into substances. Normally the MSDS (material safety data sheet) is sought for this purpose. Oftentimes, getting the data may be impossible because of the unwillingness of the material suppliers to disclose the material composition information. An example of an MSDS is shown in the Annex.

3.1.4 Preparation of a list of hazardous substances and materials to control

Based on the substance composition of the materials of a part, you can set up a list of hazardous substances and materials to control. Table 3-4 shows an example of such a list. If a part contains RoHS-regulated substances, then a detailed analysis follows as shown in Section 3.2.

Table 3-4 Fictitious list of hazardous substances and materials to control in a part

Class	Name of regulated substances and materials	Presence (Y/N)	Documents for submission to producer			
			Analytical data (Y/N)	Substance composition (Y/N)	Improvement plan (Y/N)	Non-use certificate (Y/N)
I	Hg	N		Y		Y
	Chromium (6 compounds)	N				
	Cd and its compounds	Y	Y		Y	
	Pb and its compounds	N				
	PBBE					
	PBDE					
II	PCB					
	CFCs					
	….					
III	PVC					
	…..					

Note: Analytical data, improvement plan and non-use certificate are not required for Class II and III materials and substances.

Particular attention should be paid when preparing Table 3-4. If you are a supplier of a part classified as a high-concern material in the EU RoHS Directive or you purchase those parts from your suppliers, your product will most likely be subject to close scrutiny by the EU enforcement authority.

The EU RoHS enforcement authority's Informal Network issued an RoHS enforcement guidance document in May 2006. The document included a list of high-

concern materials that contain hazardous substances prior to the implementation of the RoHS regulation and/or materials with a high probability of containing them. It is obvious that those parts in the list below were to be made top priority for surveillance in the enforcement of the new RoHS regulation. These include:

- PVC (Cadmium and lead; as stabilizer and colorant)
- Polystyrene (PS) and acrylonitrile/butadiene/styrene (ABS) (PBDE; as flame retardant)
- Red/orange/yellow plastics (cadmium, lead and chromium VI in lead chromate; as colorant)
- Plated metal enclosures, fasteners, clips, and screws (hexavalent chromium; as chromate finish)
- Populated printed wiring boards (PWBs) and their components (lead; as solder and terminal finish)
- Decorative nameplates, buttons (mercury; as additive, colorant, curing agent)
- Switches, relays (mercury; as component of switch/relay)
- Lead solder used inside components
- Cadmium used in thick film circuits

It should be noted that most producers and suppliers had already begun or had completed eliminating hazardous substances from the parts listed above prior to the Directive.

Table 3-5 shows an industry practice for controlling high-concern materials in the Korean electronic parts suppliers and set makers (producers). Those marked with H (high) are subject to intense scrutiny to check for the presence of hazardous substances.

Table 3-5 High-concern materials controlled within the Korean electronics sector (LG Electronics, 2006)

Category	**Description**	**Hazardous substances**				
		Pb	**Cd**	**Hg**	**Cr+6**	**PBBs, PBDEs**
Polymers and rubbers	Materials consisting of outer housing, casing	H	H			L
	Print, paint material, film on outer surface	H	H			
	Colored plastics, rubber containing pigment	H	H		L	
	Plastic containing stabilizer, additives	H	H			
	Cable coating, housing, connector consisting of power cable assembly	H	H			H
	All PVC materials	H	H			

(continued on next page)

(continued from previous page)

Table 3-5 High-concern materials controlled within the Korean electronics sector (LG Electronics, 2006)

Category	Description	Hazardous substances				
		Pb	**Cd**	**Hg**	**Cr+6**	**PBBs, PBDEs**
Polymers and rubbers	Flame retardants in control box, anti-heat pan, switch socket, terminal block	H	H			H
	Expanded PE, PU materials	L	L			H
	Rubber materials reducing shocks and protecting parts	H	H			L
	Cable tie	H	M			
Metals	Existing solder	H	L			
	Pb-free solder	L	L			
	Solder in motors, sockets	H	L			
	Connecting solder between different materials and for sealing	L	H			
	Metals for cutting and quick processing	H	L			
Circuit parts	Plating materials in lead part	H				
	Inner solder of part	H				
	Non-flammable plastics in capacitor, transformer, connector, other parts	L				H
	Switch, relay		H	H		L
	IC, chip-type part		L			M
	Alloy metals in fuse	H	H			
	PVC material in parts	H	H			L
	Thin film connector	H	H			L
	LCD panel, screen	H	L	H		
Plating and surface treatment	Chromium electro-plating in plastic materials				M	
	Anti-rust chromium plating on metal surface				H	
	Surface treatment for anti-rust		H			
	Zinc plating on staple pin	H	L			
Others	Heat resistant, anti-corrosion, paint, grease	H				
	Coating and flux of PCB	H			L	
	Shining lacquer, paint, ink	H	M		M	

3.2 GENERATING ANALYTICAL DATA FOR RoHS-REGULATED SUBSTANCES OF A PART

When RoHS-regulated substances are present in the list of hazardous substances and materials to control, the material in question has to be analyzed in an analytical laboratory recognized by the producer (Section 3.2.1). Using the analytical data, a report for the analytical data of the material should be prepared (Section 3.2.2). If the report indicates the presence of RoHS-regulated substances, an improvement plan has to be prepared (Section 3.2.3). When the problem is resolved or there was no RoHS-regulated substances in the material in the beginning, you should prepare a declaration for non-use of RoHS-regulated substances (Section 3.2.4). Finally, you will need to prepare a warranty for RoHS compliance to the producer (Section 3.2.5).

(Section 3.2.1). Using the analytical data, a report for the analytical data of the material should be prepared (Section 3.2.2). If the report indicates the presence of RoHS-regulated substances, an improvement plan has to be prepared (Section 3.2.3). When the problem is resolved or there was no RoHS-regulated substances in the material in the beginning, you should prepare a declaration for non-use of RoHS-regulated substances (Section 3.2.4). Finally, you will need to prepare a warranty for RoHS compliance to the producer (Section 3.2.5).

3.2.1 Performing analysis for hazardous substances in selected material

Since their analysis is quite detailed, the determination for heavy metals should be done using ICP, and for the two brominated flame retardants by GC-MS (gas chromatography-mass spectroscopy). Typically, certified analytical laboratories identified by the producer are used. An example of a report by an analytical laboratory is shown in Section 4.1.

Caution should be exercised when sending samples to the analytical laboratory. These cautions include:

- Homogeneous sample should be sent
- An assembly should be disassembled to parts. The parts are then disassembled into materials if they are composed of more than one substance (to provide homogeneous material).

IC chips consist of a variety of homogeneous materials as shown in Figure 3-7. In general, there are several difficulties associated with securing homogeneous materials from this type of part. They include difficulties separating homogeneous materials using ordinary disassembly tools; homogeneous materials obtained are not in sufficient quantity for analysis; and samples are often contaminated by adjacent materials. Thus accurate analysis is often difficult. In addition, analytical costs are high compared to the unit price of the parts. Thus, many part suppliers opt to separate the lead frame from the main body. The main body is then ground to obtain homogeneous samples for the analysis.

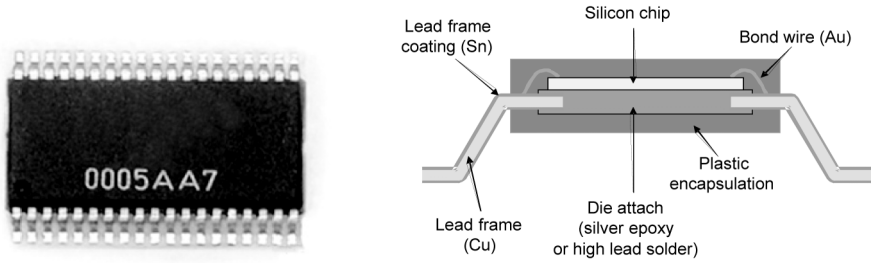


Figure 3-7 Example of IC chip, lead frame, and main body

However, this approach can lead to erroneous results as illustrated in Figure 3-8.

Example: High Pb content in one of the parts in an assembly part leading to erroneous results

Figure 3-8 is an assembly part of 20g, with parts A (10g), part B (1g), and part C (9g). The Pb content in parts A, B, and C are 10mg/kg, 10,000mg/kg, and 50mg/kg, respectively.

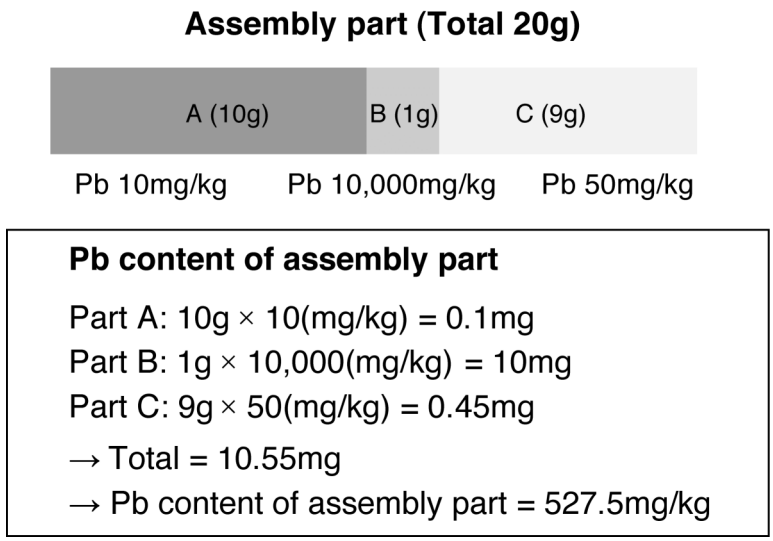


Figure 3-8 Example of high-Pb content in one of the parts of an assembly

The overall Pb content of the assembly part meets the RoHS-regulated substance limit value, although the limit value is shown to be exceeded for one of the parts. That means that, in this case, the assembly does not comply with the RoHS regulations.

It should be pointed out that compliance of a product with the maximum concentration value (MCV) of the six RoHS-regulated substances is concentration based, not mass based. Oftentimes, there is a confusion that more parts and bigger products mean a greater amount of hazardous substances; thus it may exceed the MCV. However, the concentration does not increase in proportion to the mass increase. This is because the RoHS regulation is based on the homogeneous material, not the product nor its parts.

Let's suppose the sum of the homogeneous material in the product is (a), and the sum of the specific substance in the homogeneous material in the product is (b). Then the concentration of the specific substance in the product is (b)/(a).

If the concentration is below the MCV, the product is in compliance with RoHS regulation with respect to the specific substance.

Example:

Sum of the homogeneous material in the product: Paint A: 100 g (a)

Sum of the specific substance in the homogeneous material in the product: Pb: 0.08 g (b)

Concentration: (b)/(a) = 0.08/100 = 800 ppm

MCV= 1000 ppm for Pb

In this case, the product is in compliance with RoHS regulation.

Analytical instruments are classified into two types depending on the level of detail they produce: screening method and precision method. The former provides information as to the presence of hazardous substances quickly and easily; however, it does not render accurate analytical results. The latter renders accurate analytical data; however, it is costly and time consuming. The latter is required for meeting the legal limits of RoHS-regulated substances.

Figure 3-9 is a flowchart for the test methods to determine the levels of regulated substances in EEE.

After obtaining the sample, which is a polymer, metal, or electronic material, a decision is made as to whether the screening procedure (screening analysis) or the verification procedure (detailed analysis) using a variety of test methods will be used.

The screening procedure may be carried out either by directly measuring the sample (non-destructive sample preparation) or by destroying the sample to make it uniform (mechanical sample preparation). This decision is made by judging the uniformity of the sample. A screening of representative samples of many uniform materials (such as polymers, alloys, and glass) may be done non-destructively, while for other more complex samples (such as FRU), mechanical sample preparation may be an appropriate solution. Mechanical sample preparation is the same for both the screening and the verification test procedure. (IEC62321, 2007)

Table 3-6 shows a procedure that can be used to guide the choice of the pre-treatment method and the analytical method for differing substances and materials in the verification procedure (detailed analysis) (IEC62321, 2007) (This is quite similar to the Chinese RoHS analytical standard, SJ/T 11365-2006.) It should be noted that pre-treatment methods and analytical methods differ depending on the specific materials under analysis.

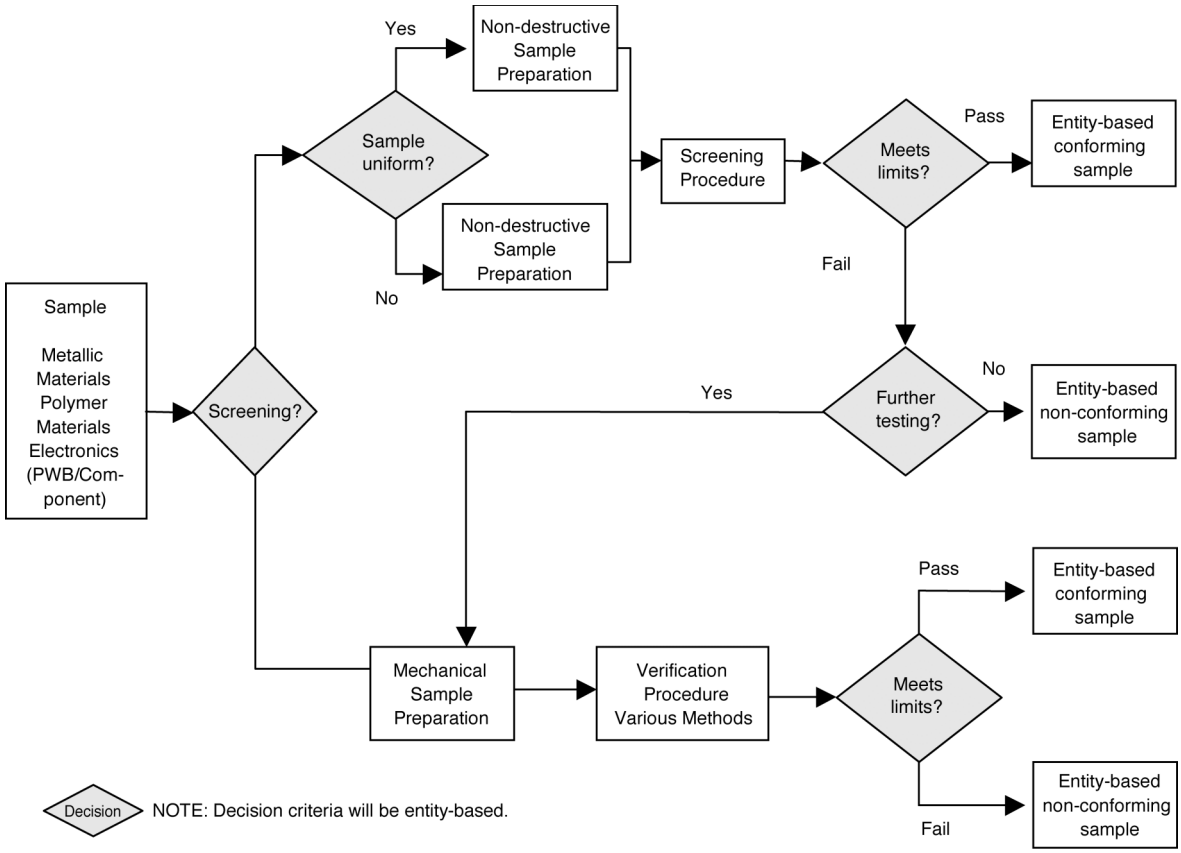


Figure 3-9 Flowchart of test methods determining RoHS-regulated substances (IEC62321, 2007)

Table 3-6 Overview of the verification procedure (IEC62321, 2007)

Steps	Substances	Polymers	Metals	Electronics (PWBs/components)
Mechanical sample preparation (5)		Direct measurement Grinding	Direct measurement Grinding	Grinding
Chemical sample preparation		Microwave digestion Acid digestion Dry ashing Solvent extraction	Microwave digestion Acid digestion	Microwave digestion Acid digestion Solvent extraction
Analytical technique definition (incl. typical margins of error)	PBB/PBDC	GC-MS (Annex A)	NA	GC-MS (Annex A)
	Cr(VI)	Alkaline digestion/ colorimetric method (Annex C)	Spot-test procedure/ boiling-water-extraction procedure (Annex B)	Alkaline digestion/ colorimetric method (Annex C)
	Hg	CV-AAS, AFS, ICP-OES, ICP-MS (7)		
	Pb/Cd	ICP-OES, ICP-MS, AAS (8)	ICP-OES, ICP-MS, AAS (9)	ICP-OES, ICP-MS, AAS (10)

After the verification procedure has been carried out, it should be decided whether the sample meets the limits based on the entity's criteria for regulated substances.

3.2.2 Preparation of report for analytical data of material

Once analysis of the substances in the material of a part with respect to hazardous substances and other chemical substances is completed, the analytical data need to be processed to meet the requirements of the data report format of the producer. The report format varies from one producer to another; thus reporting can be time consuming. Nonetheless, there is a harmonized format published by the JGPSSI (Japan Green Procurement Survey Standardization Initiative).

An example of a report for the analytical data is shown in Table 3-7. The part structure example given in Section 3.1.2 (Table 3-2) was used to prepare Table 3-7. The analytical results from a recognized testing laboratory should accompany the report.

Table 3-7 Example of analysis report for "Part A"

Part name	Material name	Material manufacturer	Manufacturing process	Concentration (ppm)					
				Cd	Pb	Hg	Cr+6	PBBs	PBDEs
Part A	Paint A	Z company	Spray A				500		
	Paint B	Y company	Spray B		50				
	Coating A	X company	..	45					
	Coating B	W company	..	30					
	Raw material A	V company	..		100				150
	Raw material B	U company	..			200		40	
	Packaging	T company	…						300

Note: Blank under the concentration means below detectable level.

Another example is shown below from Toshiba Corporation and JGPSSI (JGPSSI, 2006) for the data processing and reporting format for the analytical results of a part (an assembly in this case). The reporting format follows the JGPSSI model.

The part used in the Toshiba example is an assembly for an aluminum electrolyte capacitor. Figure 3-10 shows the schematic representation of the capacitor (JGPSSI, 2006).

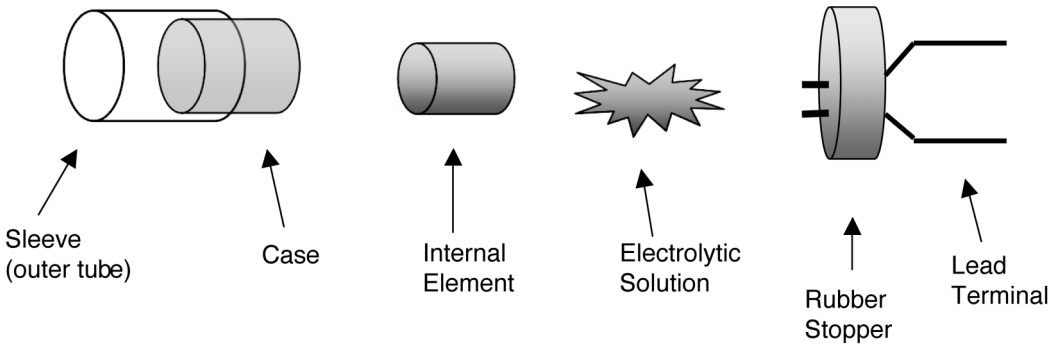


Figure 3-10 Schematic representation of part (aluminum electrolyte capacitor)

Table 3-8 shows the calculation method for the substances present in the part using the analytical data and weight of each sub-part.

Table 3-8 Calculation of amount of substances in a part (aluminum electrolyte capacitor) (Toshiba)

Sub-part	Substance/material of concern	Quantity	Calculated results
Sleeve (outer tube) PVC 0.3 g	PVC Dibutyl phthalate Antimony Trioxide	50% 40% 10%	0.3 g * 0.5=150 mg 0.3 g * 0.4=120 mg 0.3 g * 0.1*0.835+=25 mg
Case	Not contained		
Internal element (body) 0.2 g	Antimony Lead	20 mg 9 mg	20 mg 9 mg
Electrolytic solution	Not contained		
Lead terminal 0.1 g	Lead Copper	10 mg 20 mg	10 mg 20 mg
Rubber stopper	Not contained		

+ 0.835 is a conversion factor to convert antimony trioxide to antimony.

Based on the calculation results in Table 3-8, a report of the analytical data of the part corresponding to the producer's data format is completed. Table 3-9 presents the final report.

Table 3-9 Final report on analytical data of part substances (aluminum electrolyte capacitor) (Toshiba)

Substance (and material) of concern	Quantity	Application	Intended use	Remarks
Antimony and its compounds	45 mg	Sleeve, etc.	Flame retardant	25+ 20=45 mg
Lead and its compounds	19 mg	Lead terminal, etc.	Solder plating	9+10=19 mg
PVC	150 mg	Sleeve	Main ingredient	
Phthalate esters	120 mg	Sleeve	Plasticizer	
Copper and its compounds	20 mg	Lead terminal	Main ingredient	

In Table 3-9, the Application column specifies the name of the sub-part (e.g., sleeve, case, rubber stopper, etc. in Figure 3-10) of the part supplied to the producer. The name can vary among different suppliers, although the part itself is the same. This is because there are no harmonized standards on terminology (nomenclature) of parts (including assembly) and sub-parts. Thus, it's acceptable to use the generic name, common name, or specific name in the specifications of a part. However, this practice should not be encouraged to avoid unnecessary confusion in the supply chain.

Examples of applications include:

- When the part in question is a single electronic part; e.g., ceramic material, internal electrode, or external electrode in a layered ceramic capacitor, lead wire, electrolytic solution, sealing material, electrode foil in electrolytic capacitor, rubber contact point, springs, plastic cover for switch, etc.
- When the part in question is an assembly; i.e., multi-layered ceramic capacitor (MLCC), electrolytic capacitor, printed circuit board, chip resistor, etc.

The column "Intended use" in Table 3-9 helps to clarify the intended use of the substances included in the parts. Examples include: stabilizer, plasticizer, colorant, soldering, flame retardant, antiseptic ingredient, main ingredient, heat stabilizing, improving electric and/or mechanical properties, etc.

3.2.3 Preparation of improvement plan

In the event the concentration of the RoHS-regulated (Class I) substances exceeds the producer's control limit, an improvement plan should be developed. Table 3-10 is an example of an improvement plan of a fictitious part, "Assembly A."

Table 3-10 Improvement plan for "Assembly A"

Substance	Control limit (ppm)	Analytical results (ppm)	Intended use	Improvement plan	Target date
Cd	50	150	Stabilizer for PVC	Substitution PVC for another material containing no Cd	August 2008
…					

3.2.4 Preparation of declaration for non-use of RoHS-regulated substances

Once all analytical data meet the RoHS-regulated substances control limit, the supplier submits to the producer the declaration of non-use of RoHS substances in the supplier's parts. The same applies to the case in which there are no RoHS-regulated substances in the material in the beginning. An example of a declaration for non-use of RoHS-regulated substances is shown in the Annex.

3.2.5 Preparation of warranty for RoHS compliance

When all the documents are ready, the supplier should then submit a warranty for RoHS compliance to the producer. An example of a warranty for RoHS compliance is shown in the Annex.

ANNEX

Self-declaration of RoHS Compliance (Samsung Electronics)

This is a self-declaration of Samsung products complying with the EU's RoHS regulations. It is signed by the vice president in charge of customer satisfaction and is available upon request by customers.

SAMSUNG ELECTRONICS

Samsung Electronics Co.Ltd
416, Maetan-3Dong, Suwon-City, Korea

Declaration of RoHS Compliance for Samsung Electronics' Products

Samsung Electronics Co. Ltd (the "Company") hereby declare that all Samsung Electronics' products placed on the European Community market by the Company & its subsidiaries after 1 July 2006 are compliant with EC Directive 2002/95/EC on the Restriction of Certain Hazardous Substances in Electrical and Electronic Equipment (commonly known as the EU RoHS Directive); i.e., they are RoHS compliant.

RoHS compliant means that where the product falls under the scope of the EU RoHS Directive, this product does not contain the following substances:

- Mercury (Hg) 0.1%
- Lead (Pb) 0.1%
- Cadmium (Cd) 0.01%
- Hexavalent Chromium (Cr+6) 0.1%
- Polybrominated Biphenyls (PBB) 0.1%
- Polybrominated Diphenyl Ethers (PBDE) 0.1%

in excess of the indicated maximum concentration values by weight in homogenous materials, unless the substance is subject to an exemption specified in the Directive[1].

This declaration represents the Company's knowledge and belief which is partially based on information provided by third party suppliers.

Further details about Samsung Electronics' RoHS compliance programme can be found in the accompanying FAQ document or at:
http://www.samsung-europe.com/sustainability

Signature: HYUN MOON Lim

Vice President,

Customer Satisfaction Management Center

---

http://europa.eu.int/comm/environment/waste/weee_index.htm

Source: http://www.samsung.com

Warranty Letter (submitted to Samsung Electronics)
Suppliers must submit a letter of warranty declaring that their parts do not contain RoHS-regulated substances thus confirming they are RoHS compliant. Below is an example of the letter of warranty by a part supplier to Samsung Electronics.

Letter of Warranty and Representation ("Letter")

To: Samsung Electronics Co., Ltd. ("SEC") and its affiliated companies
From: _____("Company")

1. Company hereby warrants and represents as follows:
   A. Company complies with all relevant international regulations concerning the substances with environmental impacts.
   B. Company complies with the Samsung Electronics Standards for Control of Substances with Environmental Impacts within Products "Samsung Environmental Standards, 0QA-2049" in controlling environmentally hazardous substances.
   C. The documents and data sheets on the substances with environmental impacts contained in Company's supplies including, without limitation, products, parts, components, raw materials and packaging materials, are accurate and truthful.

2. Company agrees to defend, hold harmless, and indemnify SEC from any claim arising out of or related to Company's failure to comply with the above warranties and representations including, without limitation, all counsel fees and legal costs, judgments, orders, awards, and/or any damages arising out of and/or related to any such claim or claims.

3. This Letter shall be effective from_____ to_____, and thereafter, shall be automatically renewed for each additional year unless SEC or Company objects such renewal in writing at least a month prior to an expiration date.

4. All disputes related to this Letter shall be finally settled by arbitration. The arbitration shall be conducted in English and in accordance with the Commercial Arbitration Rules of the Korean Commercial Arbitration Board. The arbitration shall take place in Seoul, Korea. The award rendered by the arbitrator shall be final and binding for both SEC and Company.

The undersigned is an authorized representative of the Company.

Signature: _____ Date: _____

Print Name and Title:
Company Name and Address:

Source: Samsung Electronics CS Management Center , Eco-Partner Certificate Manual for RoHS, 2004

Example of MSDS

MATERIAL SAFETY DATA SHEET **Page: 1**

Metal Cleaner

HEALTH	3
FLAMMABILITY	1
PHYSICAL HAZ.	1
PPE	n

Revision: 11/27/1996

Printed: 12/01/2003
Date Created: 12/09/1996

1. Product and Company Identification

Product Code: DX579
Product Name: Metal Cleaner
Manufacturer Name and Address:
Company Name PPG Industries, Inc.
4325 Rosanna Drive
P.O. Box 9
Alison Park, PA 15101
Emergency Contact 1 Emergency Medical/Spill Info. (304)842-1300
Information Contact Technical Information (614)363-9610
Chemical Family: ACID

2. Composition/Information on Ingredients

Hazardous Component: (Chemical Name)	CAS #	Percentage	OSHA TWA	ACGI TWA	Order Limit
1. Ethanol, 2-Butoxy-	111-76-2	10.0 – 20.0 %	(S) 25 ppm	(S) 25 ppm	No data.
2. Diethylene glycol monobutyl ether	112-34-5	10.0 – 20.0 %	Not Estab.	Not Estab.	No data.
3. Phosphoric acid	7864-38-2	30.0 – 40.0 %	1 mg/m^3	1 mg/m^3	No data.

3. Hazards Identification

Emergency Overview

Harmful or fatal if swallowed. May be corrosive. This product contains a material which causes skin burns. This product contains a material which causes irreversible eye damage. May be harmful if absorbed through the skin. Vapor and/or spray mist harmful if inhaled. Vapor irritates eyes, nose, and throat. Vapor generated at elevated temperatures irritates eyes, nose, and throat.

Route(s) of Entry: Inhalation? No Skin? No Eyes? No Ingestion? No

Potential Health Effects (Acute and Chronic)

INGESTION: Harmful or fatal if swallowed.

EYE CONTACT: This product contains a material which causes irreversible eye damage.

SKIN CONTACT: May be corrosive. This product contains a material which causes skin burns. May be harmful if absorbed through the skin.

INHALATION: Vapor and/or spray mist harmful if inhaled. Vapor irritates eyes, nose, and throat. Vapor generated at elevated temperatures irritates the eyes, nose, and throat. Repeated exposure to high vapor concentrations may cause irritation of the respiratory system and permanent brain and nervous system damage.

CHRONIC OVEREXPOSURE: Avoid long-term and repeated contact. This product contains an ethylene series glycol ether and/or acetate which has been shown to cause adverse effects on the kidneys, lever, blood and/or blood-forming tissue. This product contains diethylene glycol monobutyl ether (DEGBE). DEGBE consumed in drinking water at low levels by rats for 30 days caused injury to either the liver, kidney, spleen, or testes.

 ANSI Format

Source: www.mirsinfo.com

4. RoHS COMPLIANCE CASE STUDIES

Parts suppliers in Korea, China, and Japan were chosen to illustrate compliance in these markets to the RoHS Directive. Since parts suppliers do not place their products directly on the EU market, their compliance has aimed at meeting the demand of their customers (producers). The actual compliance case study each has some or all of the following elements. These elements reflect the usual requirements for a supplier to be RoHS compliant as described in Chapter 3.

- Supplier name and type of business
- Declaration of RoHS compliance
- Supplier declaration on material composition and substance
- Analytical results of materials
- Certificate of participation in green supplier program
- Non-use certificate for RoHS substances
- Letter of warranty

In the cases presented here, only the Korean parts supplier actually includes all of the items listed above. In the case of China, the requirements from a set maker for its suppliers meeting the RoHS requirements are described. Although the Chinese case does not follow the elements listed above explicitly, all the elements are embedded in the checklist for the audit of the RoHS management system of the suppliers for certification. In the case of the Japanese parts supplier, most of the elements listed above also cannot be found explicitly. This does not mean that it does not submit to its customers all the elements listed above. Rather, all the elements are embedded in the RoHS management system so it complies with the RoHS requirements imposed by its customers.

4.1 KOREAN PARTS SUPPLIER

Source: http://www.sem.samsung.co.kr/en/indexMain.jsp

4.1.1 Supplier name and type of business

Name: Samsung Electro Mechanics

Type of business: Manufacturing of the following parts:
Main boards (HDI, SEMBrid), IC substrates (BGA, flip chip BGA), capacitors (MLCC, Tantalum capacitors, x2Y capacitors), chip resistors, chip inductors, EMC components (chip beads, EMI filters, varistors), LTCC components (diplexers, etc.), precision motors (vibration motors, etc.)

4.1.2 Declaration of RoHS compliance

We, Samsung, declare that our component MLCC is produced in accordance with EU RoHS Directive.

1. RoHS Compliance and restriction of Br

The following restricted materials are not used in packaging materials as well as products in compliance with the law and restriction

- Cd, Pb, Hg, Cr+6, As, Br and the compounds, PCB, asbestos
- Brominated materials : PBBs, PBBOs, PBDO, PBDE, PBB

2. No use of materials destroying ozone layer

The following ozone depleting substances (ODS) are not used in our production process.

- ODS: Freon, Halon, 1-1-1 TCE, CC14, HCFC

3. Environmental logo with RoHS compliance

The following logo is applied to the label and packaging box from July 1, 2006

- ▹ ECOPARTS : Environmentally friendly (ECO) parts of all kinds
- ▹ Color (Blue): Samsung's own color, clean water
- ▹ Leaf: (Leaf = component)
- ▹ Wave: Expand Samsung's environmentally friendly management

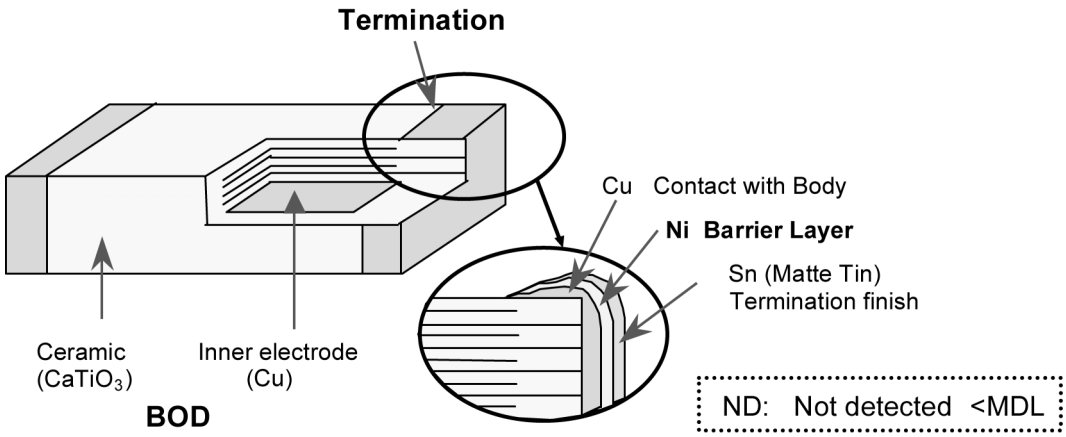
4.1.3 Supplier's declaration on material composition and substance

We, Samsung, declare that our MLCC is in compliance with the RoHS Directive. The detailed information about the ingredients of requested items is as below.

Part name: C (COG) Cu electrode

Materials declaration:

Materials Declaration



	Material group	Raw material	CAS No.	Analysis result (PPM)					
				Cd	Pb	Hg	Cr+6	PBBs	PBDEs
Body	Dielectric	Calcium Titanate (CaTiO3)	12049-50-2	ND	ND	ND	ND	ND	ND
	Inner electrode	Copper (Cu)	7440-50-8	ND	ND	ND	ND	ND	ND
Termination	1st layer (Contact with body)	Copper (Cu)	7440-50-8	ND	ND	ND	ND	ND	ND
	2nd layer (Barrier layer)	Nickel (Ni)	7440-02-0	ND	ND	ND	ND	ND	ND
	3rd layer	Tin (Sn)	7440-31-5	ND	ND	ND	ND	ND	ND

Note: MDL = Method Detection Limit

Declaration on substance composition of material:

Banned Substances (RoHS-regulated or Class I substances)

Substance	Use (O/X)	Purpose of use
Lead and its compounds	X	
Mercury and compounds	X	
Hexavalent chromium	X	
Cadmium and its compounds	X	
Polybrominated biphenyls (PBBs)	X	
Polybrominated diphenyl ethers (PBDEs)	X	

Controlled substances (Class II substances)

Substance	Use (O/X)	Purpose of use
Antimony and its compounds	X	
Arsenic and its compounds	X	
Beryllium and its compounds	X	
Barium and its compounds	X	
Manganese and its compounds	X	
Organic-tin compounds	X	
Nickel and its compounds	O	Plating (Barrier layer)
Bismuth and its compounds	X	
Copper and its compounds	O	Inner electrode/ Termination
Asbestos, etc.	X	
Cyanide	X	
Polychloroterphenyls (PCTs)	X	
Polychlorinated biphenyls (PCBs)	X	
Polyvinyl chloride (PVC)	X	
Palladium and its compounds	X	
Silver and its compounds.	X	

Signature of Authorized Company Representative

Position and E-mail
Senior Manager; illkyoo.park@samsung.com

Address and Phone number
314, Maetan-3dong, Youngtong-Gu, Suwon-Si, Kyungki-Do,
442-743, Korea
Tel. 82-31-210-3694

Company Environmental Authorized Person (if other than above) and E-mail
Angelina Kim; japann.kim@samsung.com

Address and Phone number
Same as above
Tel. 82-31-210-5513

4.1.4 Analytical results of materials

(Test Report page 1 of 4)

Intertek

TEST REPORT

Applicant : SAMSUNG ELECTRO-MECHANICS CO., LTD.
Address : 314, Maetan-3Dong, Yeongtong-Gu,
Suwon-City, Gyunggi-Do, 443-742 Korea

Page: 1 of 4

Report No. RT07R-6953-005 Date: Nov. 16, 2007

Sample Description	: The following submitted sample(s) said to be:-
Name/Type of Product	: Ceramic Chip Capacitor
Name of Material	: Materials are ceramic & metal/Gray Ceramic, Silver Metal
Sample ID No.	: RT07R-6953-005
Item No.	: MLCC C(C0G-Cu) TYPE (CL**C******G***)
Manufacturer/Vender	: SAMSUNG ELECTRO-MECHANICS CO., LTD.
Sample received	: Nov. 13, 2007
Testing Date	: Nov. 13, 2007 ~ Nov. 16, 2007
Testing Laboratory	: Intertek Testing Center
Testing Environment	: Temperature : (22 ~ 26) ℃ Relative Humidity: (55 ~ 65) %
Test Method(s)	: Please see the following page(s).
Test Result(s)	: Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.
* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.
* Note 3 : The item no. is assigned by client and indicated according to their requirement and guarantee letter.

Tested by, Authorized by,

E.Y.Lee / Chemist H.W.Yoo / Lab Manager

Intertek Testing Center

Seoul Office : Tel : 02-2109-1250 Fax : 02-2109-1259 Gumi Office : Tel : 054-462-7647 Fax : 054-462-7657 Web Site : www.Intertek.co.kr
Seoul Lab. : #709, 7Fl, Ace Techno Tower V, 197-22, Guro-3Dong, Guro-Gu, Seoul 152-766 Korea Tel : 02-2109-1260 Fax : 02-2109-1258
Ulsan Lab. : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea Tel : 052-257-6754 Fax : 052-276-6792

(Test Report page 2 of 4)

Intertek

TEST REPORT

Page: 2 of 4
Report No. RT07R-6953-005 Date: Nov. 16, 2007

Sample ID No. : RT07R-6953-005
Sample Description : Ceramic Chip Capacitor

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	mg/kg	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	5	N.D.
Mercury (Hg)	mg/kg	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	2	N.D.
Hexavalent Chromium (Cr^{6+})	mg/kg	US EPA 3060A and determined by UV-VIS	1	N.D.
Polybrominated Biphenyl (PBBs)				
Monobromobiphenyl	mg/kg	With reference to US EPA 3540C, by solvent extraction and determined by GC/MS	5	N.D.
Dibromobiphenyl	mg/kg		5	N.D.
Tribromobiphenyl	mg/kg		5	N.D.
Tetrabromobiphenyl	mg/kg		5	N.D.
Pentabromobiphenyl	mg/kg		5	N.D.
Hexabromobiphenyl	mg/kg		5	N.D.
Heptabromobiphenyl	mg/kg		5	N.D.
Octabromobiphenyl	mg/kg		5	N.D.
Nonabromobiphenyl	mg/kg		5	N.D.
Decabromobiphenyl	mg/kg		5	N.D.
Polybrominated Diphenyl Ether (PBDEs)				
Monobromodiphenyl ether	mg/kg	With reference to US EPA 3540C, by solvent extraction and determined by GC/MS	5	N.D.
Dibromodiphenyl ether	mg/kg		5	N.D.
Tribromodiphenyl ether	mg/kg		5	N.D.
Tetrabromodiphenyl ether	mg/kg		5	N.D.
Pentabromodiphenyl ether	mg/kg		5	N.D.
Hexabromodiphenyl ether	mg/kg		5	N.D.
Heptabromodiphenyl ether	mg/kg		5	N.D.
Octabromodiphenyl ether	mg/kg		5	N.D.
Nonabromodiphenyl ether	mg/kg		5	N.D.
Decabromodiphenyl ether	mg/kg		5	N.D.

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

Intertek Testing Center

Seoul Office : Tel : 02-2109-1250 Fax : 02-2109-1259 Gumi Office : Tel : 054-462-7647 Fax : 054-462-7657 Web Site : www.intertek.co.kr
Seoul Lab : #709, 7Fl, Ace Techno Tower V, 197-22, Guro-3Dong, Guro-Gu, Seoul 152-766 Korea Tel : 02-2109-1260 Fax : 02-2109-1258
Ulsan Lab : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea Tel : 052-257-6754 Fax : 052-276-6792

(Test Report page 3 of 4)

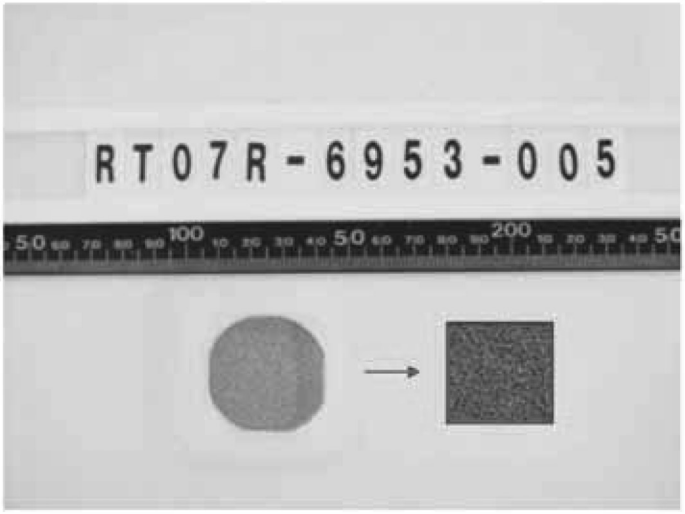
Intertek

TEST REPORT

Report No. RT07R-6953-005 Date: Nov. 16, 2007

Sample ID No. : RT07R-6953-005
Sample Description : Ceramic Chip Capacitor

* View of sample as received;-



Intertek Testing Center

Seoul Office : Tel : 02-2109-1250 Fax : 02-2109-1259 Gumi Office : Tel : 054-462-7647 Fax : 054-462-7657 Web Site : www.Intertek.co.kr
Seoul Lab : #709, 7Fl, Ace Techno Tower V, 197-22, Guro-3Dong, Guro-Gu, Seoul 152-766 Korea Tel : 02-2109-1260 Fax : 02-2109-1258
Ulsan Lab : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea Tel : 052-257-6754 Fax : 052-276-6792

(Test Report page 4 of 4)

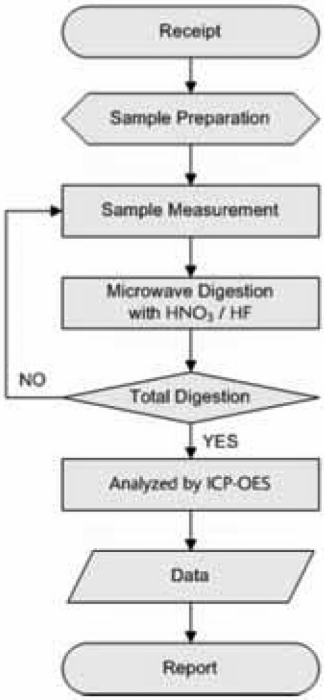
Intertek

TEST REPORT

Page: 4 of 4
Report No. RT07R-6953-005 Date: Nov. 16, 2007

Sample ID No. : RT07R-6953-005
Sample Description : Ceramic Chip Capacitor

Flow Chart Of Digestion (EPA 3052 For Cd, Pb)



** Remarks : The samples were dissolved totally by pre-conditioning method according to above flow chart.

Prepared by Eung Yong Lee, Chemist
Confirmed by Sang Chul Park, Senior Researcher

***** End of Report *****

Intertek Testing Center

Seoul Office : Tel : 02-2109-1250 Fax : 02-2109-1259 Gumi Office : Tel : 054-462-7647 Fax : 054-462-7657 Web Site : www.intertek.co.kr
Seoul Lab. : #709, 7Fl, Ace Techno Tower V, 197-22, Guro-3Dong, Guro-Gu, Seoul 152-766 Korea Tel : 02-2109-1260 Fax : 02-2109-1258
Ulsan Lab. : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea Tel : 052-257-6754 Fax : 052-276-6792

4.1.5 Certificates for green supplier program

Certificate for Sony Green Partner program

Certificate
of
Green Partner

SKD 5431

Presented To:

SAMSUNG JAPAN CORPOATION
SAMSUNG ELECTRO-MECHANICS CO., LTD SUWON FACTORY

This is to certify that you have successfully established
an environmental management system
that has met the requirements of the Sony Green Partner Program

Term of Validity : 2007/8/1 ~ 2009/7/31
Issued on : 2007/7/31
Approved and Issued by : Procurement Center, Sony Corporation

Toshiyuki Kikuchi
VP, Senior General Manager, Procurement Center, Sony Corporation

SONY

41086

Certificate for Samsung's Eco-partner program

SAMSUNG ELECTRONICS

Eco-Partner Certificate

Certificate Number : EPC - 0120
Certificate Period : Mar,'05 ~ Feb,'06

Samsung Electronics hereby certifies that
RALEC ELECTRONIC CORPORATION
as **Eco-Partner Affiliate Company**. This company has fulfilled the Samsung Electronics Standards for control of substances with environmental impacts within products, and has established stable environmental quality control system.

February. 28th., 2005

Jong-Yong Yun
Vice Chairman & C.E.O
Samsung Electronics Co., Ltd.

4.1.6 Non-use certificate for RoHS substances

Form 1. Non-use certificate

Non-use certificate

Description	For approval / For mass production	Submitting date	20 . .

Cooperating suppliers				
Company name		Approval	Person in charge	Head of Quarter
Contact	Tel	Name		
e-mail		Signature		

LG Electronics Part No.		Part production date	
Maker Part No.		Production plant	
Part name		Delivery volume	

This is to certify that materials used and contained in the materials and products that we supply to your company, meet the standards of the checked items listed below.

-below-

□ We meet the standards of LG Electronics for six major substances (Pb, Cd, Cr+6, Hg, PBB, PBDE) as designated by RoHS for control.

□ Maximum heat-resisting temperature and time
Maximum heat-resisting temperature: _____℃ Maximum heat-resisting time: _____Sec
※Records are requested if they are chip parts to be actually installed on the PCB (Printed Circuit Board)

□ Pb-Free soldering (all solder cream, bars and wires included) is available to apply.

Note.
1. All the contents written on these documents must be created on the basis of facts, and cooperating suppliers must submit the data immediately whenever LG Electronics requests.
2. In the case that these documents are used for approval purposes, cooperating suppliers must submit the sample on the request. For the purpose of mass production, it must be submitted at the time of delivering the first product.
3. When submitting through HSMS, follow form of the system.

Source: http://www.lge.co.kr/cokr/about/environ/purity_03.jsp#

4.1.7 Letter of warranty

This is a letter of warranty for the parts supplied to Samsung Electro Mechanics. This is to ensure that suppliers warrant that their parts are in compliance with the RoHS Directive and state legal obligations. The same form is used when submitting the letter of warranty to the set maker (e.g., Samsung Electronics) by Samsung Electro Mechanics (the parts supplier).

Letter of Warranty and Representation("Letter")

To: Samsung Electro-Mechanics Co, Ltd. ("SEMCO")
From:

1. Company hereby warrants and represents as follows:
   Company complies with all relevant international regulations concerning the substances with environmental impacts.
   A. Company complies with the Samsung Electro-Mechanics Standards for Control of Substances with Environmental Impacts within Products "Samsung Green Purchasing Standards" in controlling environmentally hazardous substances.
   B. The documents and data sheets on the substances with environmental impacts contained in company's supplies including, without limitation, products, parts, components, raw materials and packaging materials, are accurate and truthful.
2. Company agrees to defend, hold harmless, and indemnify SEMCO from any claim arising out of or related to Company's failure to comply with the above warranties and representations including, without limitation, all counsel fees and legal costs, judgments, orders, awards, and/or any damages arising out of and/or related to any such claim or claims.
3. This Letter shall be effective from _____to _____ and thereafter, shall be automatically renewed for each additional year unless SEMCO or Company objects such renewal in writing at least a month prior to an expiration date. (Basically, effective period should be 1 year.)
4. All disputes related to this Letter shall be finally settled by arbitration. The arbitration shall be conducted in English and in accordance with the Commercial Arbitration Rules of the Korean Commercial Arbitration Board. The arbitration shall take place in Seoul, Korea. The award rendered by the arbitrator shall be final and binding for both SEMCO and Company.

The undersigned is an authorized representative of the Company.

Signature: _____ Date:

Printed Name and Title:

Company Name and Address:_____

4.2 CHINESE CONSUMER ELECTRONICS MAKER

RoHS compliance requirements in the Chinese electronics industry tend to rely on third-party verification and certification of the RoHS management system rather than an in-house green supply chain certification system. This is the main difference between the Chinese electronics industry and the Korean and Japanese electronics industry. This is because implementing a company's own certification and control system takes much in-house resources and expert knowledge so that third-party certification can be a convenient and reliable resource. Third-party verification and certification is also more common in the Taiwan, Singapore, and to some extent Hong Kong electronics industries.

Figure 4-1 is an example of a Chinese consumer electronics company (set maker).

Notification of an audit for RoHS compliance by supplier
(Chinese consumer electronics company case)

In conjunction with the implementation of the RoHS Directive in the EU and the Chinese RoHS regulations, all suppliers are required to conform to these RoHS regulations by end of July, 2006. We plan to audit the supplier's RoHS management system and the suppliers are expected to submit evidence for the compliance of the RoHS regulations. There are two options for the verification including:

- You are to complete the assessment of your RoHS management system based on a third-party system before the due date; or
- You obtain certificate for the RoHS management system from a certification body recognized by us and submit the certificate to us before the due date. Due date is September 30, 2006.

In addition, there are other factors to consider which includes:

Cost
If you pass the audit, there will be no cost charged to you. However, if you fail to pass on the first try, you are to pay (x amount) RMB/person-day for the audit. This amount will be deducted from the payment to your supplied parts.

Audit schedule
We will audit your facility from (date) to (date). Contact details of the third-party certification body are:

Certification body	Contact person	Phone	Mobile	Email
DNV				

DNV: (Det Norske Veritas)

(continued on next page)

(continued from previous page)

Others
If you fail to pass the audit on the first try, you shall submit an improvement plan signed by the CEO to rectify the failure. The grace period for the improvement depends upon the nature of the failure. You will be audited again during the grace period. If failed, there is no second chance.

A supplier passing the RoHS management system audit and meeting our other requirements can supply parts to us. If you fail to pass the audit or request for an extension without due reason or provide false information, we will terminate you immediately from supplying parts to us and we have the legal right to demand compensation for any damage accrued from your action.

Purchasing department of "A" Chinese Electronics Co.
2006.8.28

Acknowledgment of receipt
I acknowledge the receipt of the RoHS audit notification from you and not only understand the significance of the audit but also will deliver the feedback to the CEO within one working day.

Supplier name:

Received by:

Date of receipt:

Signature:

Figure 4-1 Example of Chinese consumer electronics company's initiative to ensure suppliers meet RoHS requirements

Source: http://www.haier.com

On the next pages is a checklist by a third party for the verification and certification of the RoHS management system of a supplier. This checklist is used for the audit of the RoHS management system of the supplier. Upon successful completion of the audit, the supplier is awarded with a certificate by the certification body. The set maker then accepts the certificate as evidence of the RoHS compliance. In addition, as shown in Figure 4-9, the set maker may ask additional information before approving a parts and material maker to be its supplier.

The checklist consists of three parts: i) composition of a part, its material declaration, and substance declaration; ii) analytical test results; and iii) RoHS management system. This is essentially the same as those stipulated in Chapter 3; thus it covers all the elements listed above. The Korean example in Section 4.1 is in essence the same as the Chinese example. The only difference is the entity that audits the RoHS management system: the

set maker or an independent third party such as a certification body. By providing the details for the items listed in Table 4-1, a supplier discloses all information related to RoHS compliance.

Part A in Table 4-1 corresponds to the declaration on material composition and substance, and to some extent the supplier name and type of business. Part B corresponds to the analytical results of the materials. Part C corresponds to the declaration of RoHS compliance, green supplier program (certificate given by the third party), non-use certificate for RoHS substance, and letter of warranty.

Table 4-1 Example of checklist for verification and certification of an RoHS management system when conducted by a third party

PRODUCT MODEL AUDIT TRAIL CHECKLIST (Verification of records of sampled product which has been delivered)					
		Non-conformity	**Corrective/ Preventive action**	**Department**	**Verification**
Part A	**Declaration Form**				
1.1	Does the model number define a unique serial No. representing the detailed features of the product and providing traceability and identification to the production conditions at the manufacturing site?				

(continued on next page)

PRODUCT MODEL AUDIT TRAIL CHECKLIST (Verification of records of sampled product which has been delivered)					
		Non-conformity	**Corrective/ Preventive action**	**Department**	**Verification**
Part A	**Declaration Form**				
1.2	Does the declaration form contain all the components? Solder, lubricant, paints, and other supplementary materials should be considered as "components." (Verify the contents by comparison with: - the actual product, - bill of material, - the weights of components (individual and total weight).)				
1.3	Is each component properly decomposed into homogenous materials? (Verify the contents by reality check and weight configurations.)				

(continued on next page)

PRODUCT MODEL AUDIT TRAIL CHECKLIST (Verification of records of sampled product which has been delivered)					
		Non-conformity	**Corrective/ Preventive action**	**Department**	**Verification**
Part A	**Declaration Form**				
1.4	Is each homogenous material properly decomposed into substances? (Verify the contents by reality check and weight configurations.)				
1.5	Is the weight data on the declaration form accurate? (Verify the accuracy of the data on the declaration form by reality check.)				
Part B	**Test Report (using IEC 62321 as a guide)**				
2.1	Is the test carried out by a qualified organization? (Ref. Section 4.1 of IEC 62321)				
2.2	Are analytical test procedures available and meet the requirements of Section 4.1 of IEC 62321?				

(continued on next page)

PRODUCT MODEL AUDIT TRAIL CHECKLIST (Verification of records of sampled product which has been delivered)					
		Non-conformity	**Corrective/ Preventive action**	**Department**	**Verification**
Part B	**Test Report (using IEC 62321 as a guide)**				
2.3	Does the test report provide traceability to declaration form (identification/ specifications, sampling time, location, specific usage, etc.) and meet the reporting requirements of Section 4.5 of IEC 62321?				
2.4	Is the method of pretreatment approved or considered as a generally acceptable practice?				
2.5	Is the method of testing approved or considered as a generally acceptable practice?				
2.6	Does the test report specify the level of accuracy/uncer-tainty of the testing equipment?				

(continued on next page)

PRODUCT MODEL AUDIT TRAIL CHECKLIST (Verification of records of sampled product which has been delivered)					
		Non-conformity	**Corrective/ Preventive action**	**Department**	**Verification**
Part C	**Processing Records for Selected Sample**				
3.1	Do received inspection records comply with the requirements of the RoHS management system requirements? (Ref. 2.5.5 of management system checklist)				
3.2	Were materials/ components supplied by approved suppliers? (Ref. 2.5.4 of management system checklist)				
3.3	Were declaration forms of materials and components properly verified in accordance with RoHS management system requirements? (Ref. 3.1.4 of management system checklist)				

(continued on next page)

PRODUCT MODEL AUDIT TRAIL CHECKLIST (Verification of records of sampled product which has been delivered)					
		Non-conformity	**Corrective/ Preventive action**	**Department**	**Verification**
Part C	**Processing Records for Selected Sample**				
3.4	Did the relevant manufacturing records reflect only RoHS complied materials/ components? (Ref. 2.5.3 and 2.5.6 of management system checklist)				
3.5	Did the outgoing inspection records comply with the RoHS management system requirements? (Ref. 2.5.9 of management system checklist)				

Source: DNV (Det Norske Veritas)

4.3 JAPANESE PARTS SUPPLIER

(Source: http://www.murata.com/info/rohs.html)

4.3.1 Supplier name and type of business

Name: Murata Manufacturing Company, Ltd.

Products: monolithic ceramic capacitors, ceramic filters, ceramic resonators, surface acoustic wave filters, multilayer ceramic devices, short-range wireless communication modules (including Bluetooth® modules), dielectric filters, isolators, circuit modules, power supplies, EMI suppression filters, coils, sensors, thermistors, trimmer potentiometers, resistor networks, high voltage resistors, and others

4.3.2 Declaration of RoHS compliance

The "Voluntary Regulation Program for Environmentally Hazardous Substances" was established in 1996 in order to reduce and eventually eliminate environmentally hazardous substances contained in the products, prior to the manufacturing of other manufacturers. The program covers six RoHS-regulated substances. Mercury, cadmium, PBB and PBDE have not been used in the products since 1990s, and new uses of these substances have been prohibited. In addition, use of hexavalent chromium for surface treatment and leads in terminals and other component connections has been eliminated. Through activities listed below, Murata Manufacturing developed alternative solutions for RoHS-designated substances by the end of 2004. These activities include: reviewing product designs, modifying existing production facilities and improved processing conditions, introducing new machinery, introducing lead-free surface treatment and lead-free solder, and developing products with strong heat resistance.

In cooperation with its customers and suppliers, Murata Manufacturing terminated in January 2006 the sale of products not in compliance with the RoHS Directive (except for the supply to specified customers that request RoHS non-compliant products because they do not place these products on the EU market).

4.3.3 Green supplier program

In order to control its part suppliers and to guarantee product specifications comply with the EU RoHS Directive, Murata placed in operation the system as shown in Figure 4-2.

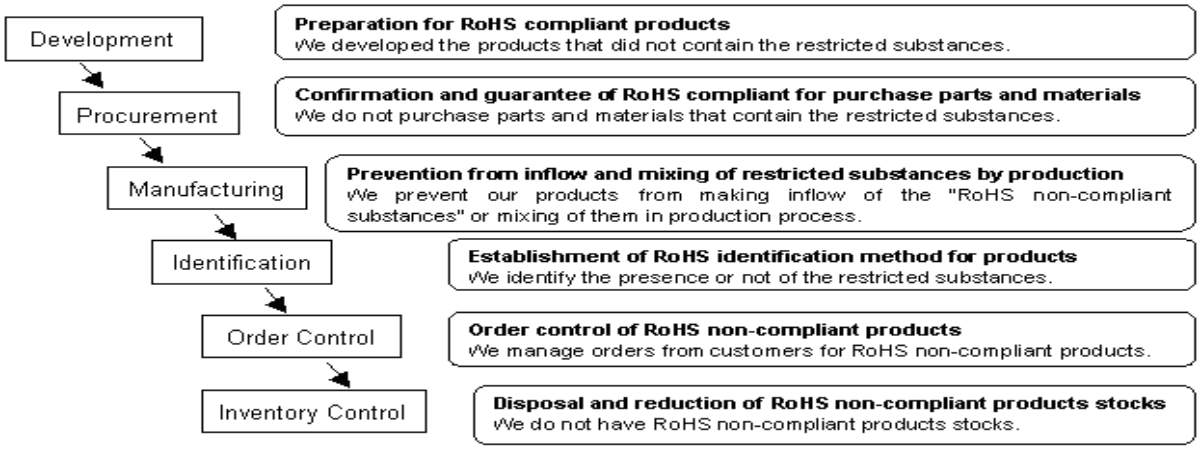


Figure 4-2 RoHS management system for parts control at Murata Manufacturing

4.3.4 Analytical results of materials, supplier's declaration on material composition and substance, non-use certificate for RoHS substances, and letter of warranty

To ensure parts suppliers comply with the RoHS regulations, each supplier's RoHS management system is audited. Murata Manufacturing also investigates whether parts from its suppliers contain RoHS-restricted substances as part of the supply chain control. In the event of non-verified parts and materials, the parts purchase is disallowed. The company also requires submission of a document stating non-use of RoHS substances in the supplied parts and a letter of warranty.

As part of the RoHS management system, the production process has been under control including introduction of inspection through analysis of received supplies, separation of EU RoHS-compliant production processes from non-compliant ones, and distinction of EU RoHS-compliant parts and materials from non-compliant ones.

5. ADDITIONAL RESOURCES RELATED TO THE RoHS DIRECTIVE

5.1 RoHS ENFORCEMENT GUIDANCE DOCUMENT, VERSION 1

(Source: EU RoHS Enforcement Authorities Informal Network, 2006)

The publication "RoHS Enforcement Guidance document version 1" was issued in May 2006. This Guidance was developed through discussions within the EU RoHS Enforcement Authorities Informal Network. It should be noted that the document is informative and advisory but has no legal authority. The RoHS enforcement authorities in each member state are bound by their own national legal structures and can only apply this guidance within the confines of those structures.

Key issues addressed in the Guidance include:

- Overall approach to RoHS compliance is based on Presumption of Conformity;
- The proposed enforcement process provides two initial routes to self-declaration, taking into account that for SMEs in particular;
- Route A provides for documentary evidence of structured international systems based on quality assurance processes in assessing producer's ability to manage RoHS compliance for those companies or organizations;
- Route B can facilitate the process by providing compliance documentation for homogeneous materials in products/parts; and,
- In cases of concern, detailed sampling and testing could be required.

Enforcement Process
Faced with the very wide range of products covered by the RoHS Directive, Member State enforcement authorities must decide which product categories and products they wish to select for further investigation. These decisions will be made following market surveillance activities and could involve one or more of the following criteria:

- Market intelligence
- Random selection
- Products known to contain materials of high concern
- High-volume products
- Short-life products
- Consumer products unlikely to be recycled
- Notification of concern from external parties
- Notification of concern from other Member States

If concerns arise, the Member State enforcement authority may decide to submit a formal request to the producer.

Although a sequential step process is envisaged, enforcement authorities may take whatever actions are appropriate to the circumstances and to the powers assigned to them in national legislation, including removal of products from the market where this is deemed to be necessary.

Indicative non-destructive testing (e.g., XRF test) for example can be used at each step of the inspection process, and notably before the documentation check. The results of this should not be used as proof of an infringement, but some enforcement authorities may proceed from this to direct sampling without prior examination of the documentation. In addition in cases of very high suspicion, direct sampling may be carried out without any previous documentation check.

There are two routes for the compliance with the RoHS regulation: Route A and Route B. The former is for large corporations and the latter for SMEs.

Route A

Process-based technical documentation
The corporation should develop an RoHS compliance assurance system (CAS) and maintain it as shown below. The CSA consists of three elements:

- A definition of the purpose of the system, its essential requirements, and specification covering compliance both within the company and within the supply chain;
- A formal defined process that implements the requirements of the system and is integrated within the organization's quality and managing system; and,
- A technical documentation system (paper and/or electronic) to support the process, and measures to assure conformity with the requirements of the system together with necessary training, tools, and infrastructure.

In order to maintain the CSA, the corporation should provide evidence of active control or maintenance of the CSA. The control process consists of three elements:

- Results of internal and supplier adults to validate Compliance Assurance System and/or processes; i.e., the supplier's ability to assure compliance;
- Evidence that the system is being followed including results of product-specific conformance assessments comprising items such as product assessment (including justification of RoHS categorization and use of exemptions), materials declaration procurement, inventory and production controls, and substance analysis where appropriate;
- Overview of any internal data system used for the management of RoHS compliance data.

Route B

Product/Part-based Technical Documentation
This route is for product and parts suppliers for ensuring the compliance of RoHS regulations. All the elements under Route B have been discussed in depth in this manual. As stated here, Route B is mainly intended for SMEs. It consists of four elements:

- Producer's or supplier's warranties/certificates declaring that the use of the restricted substances is within permitted levels.
- Producer's or supplier's complete materials declaration for each part (including revision for revised parts) and justification of RoHS categorization and use of exemptions. This declaration is limited to RoHS-regulated substances. It is not a full materials declaration.
- Analysis report for homogeneous materials in parts.
- Those who use approach B only (i.e., SMEs) must also provide evidence that procedures are being followed to show that materials declarations have been assessed to determine whether they can be trusted. Enforcement authorities will also need to see documented compliance procedures.

5.2 MAJOR CONCERNS OVER THE FUTURE OF THE RoHS DIRECTIVE

There are several impending issues surrounding the future of the RoHS Directive. They are: market surveillance in each member state; delayed development of harmonized analytical methods; review of the RoHS Directive by the EC; additional exemptions; and, inclusion of product categories 8 and 9 of the WEEE Directive into the RoHS Directive. Issues of special concern are described below.

Compliance with national laws in respect to market surveillance (MS)
The question is whether MS follows this guidance or not. This would be the case in most EU member states, however, each member state will most likely have its own guidance for the implementation of the RoHS national regulation. In the guidance, procedure and documentation requirements for the compliance with the national RoHS regulation will be defined. In most cases, it will be either self declaration or third-party certification or a combination of the two. Current RoHS enforcement activities by the authorities indicated that there were two major cases of non-compliance reported.

Delayed development of harmonized analytical method
Harmonization of the analytical method on the six RoHS-regulated substances by IEC TC111 was turned down in early 2007. After revision, the analytical method is under ballot again. If passed, the method will be published as the international standard, IEC 62321, in the latter part of 2008. Because of the delayed development of the standard, the implementation of the RoHS Directive has to be delayed. This is because without an internationally recognized standard analytical method, the accuracy of the analytical results of the sample may be subject to intensive argument in the courts as to the validity of a non-internationally harmonized analytical method.

Outcome of the EC's consultation review on the RoHS Directive
The electrical and electronics industries have maintained the position of keeping the six regulated substances as the sole restricted substances only. At the same time, they seek to increase transparency and information disclosure for the process of deciding exemptions by the EC. Response from the EC has yet to come.

Additional exemptions
Three new exemptions were approved in the TAC (technical adaptation committee) on October 3, 2007, as listed in Chapter 1 of this manual. There are many other items requested for exemption and they are still pending, waiting for a decision by TAC.

Inclusion of product categories 8 and 9
Inclusion of product category 8 (medical devices) and category 9 (monitoring and control instruments) of the WEEE Directive into the RoHS Directive is under discussion in the EC. No definite conclusions have yet been made as to the inclusion of these two product categories at the time of publication.

5.3 RoHS ENFORCEMENT ACTIVITIES BY EU AUTHORITIES

The information in this section is based upon a face-to-face hearing with the RoHS enforcement authorities in the United Kingdom, Netherlands, and Germany conducted in November 2006 and provided here for general informational purposes only. (Source: Takao Sato of Ricoh Co. Ltd, 2007)

Enforcement activity in the UK
The enforcement body in the UK is the National Weight & Measures Laboratory (NWML). Below is the procedure for RoHS market surveillance in the UK.

– Basic approach of RoHS market surveillance
When XRF screening is necessary, it will be carried out for around 10 units. In case there are many claims for the same company particularly, they will request documents to the company. For example, when they find a problem in a company that has achieved approximately 90% compliance with the RoHS regulations to date, they will carefully monitor the company while providing them with a certain time period to make a sincere effort to follow up the problem.

– Handling of "RoHS Enforcement Guidance issued in May 2006"
The Guidance is still in the draft stage and revisions will be made in the future. They think that although different opinions have been raised, a basic consensus has been achieved in the informal network created by Germany and other 14 member states.

– Steps for market surveillance
They made spot sampling tests after July 2006. The results were 99% in compliance. They found a few cases in which the restricted brominated frame retardant and lead were contained in parts used for field repair. They sent a questionnaire to confirm the management system for RoHS.

– Steps for market surveillance
First they will check the self-declaration documents submitted by a company and then conduct XRF screening at customs. They request additional documents to the company. In case there are suspicions about a particular product or company, they will request a testing lab to carry out precision measurements.

– Format for certification of conformance and submission due date
The format is not fixed. A company requested to submit specific documents must provide them within 28 days.

– Consideration for "due diligence" by enforcement authority
When noncompliance is found, they will determine corrective actions through a dialogue with the company while taking into account whether the company has been making effort of "due diligence" for compliance, establishing an appropriate management system in the company.

– Agent for precision measurement
It is up to the decision of companies whether precision measurement should be assigned to a third party or follows the methods of the IEC which is the basic criteria.

– Power of customs office
The customs office does not have the power to suspend products in custom clearing because of the UK laws.

UK Company charged under RoHS Directive (Source: EE Times on-line)
In September 2007, NWML charged a U.K. company with marketing lead-containing products. The company admitted guilt and the matter was settled without financial penalty. A documented warning, which can support legal action if the company has further violations, has been filed with the enforcement authorities. The national lab would not provide further details because the level of failure wasn't serious enough to warrant public disclosure, a spokesperson said.

Accusation reported in Denmark (Source: EE Times on line)
In early 2007, Denmark nearly saw a RoHS prosecution when officials were tipped off by an investigative TV news report on non-compliant disposable cameras. Denmark's Environmental Protection Agency ran its own tests and found some non-compliant units. The importer removed the units from the Danish market, and authorities considered the matter resolved.

As a result, Scandinavian countries are testing products after a massive sweep across Denmark, Sweden, and Finland. Officials selected a range of consumer items from 25 categories and are examining them for RoHS violations. Results were expected by December, 2007.

REFERENCES

AV Systems, Inc., http://www.mirsinfo.com/.

EC Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) (2003).

EC Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) (2003).

EC Frequently Asked Questions (FAQ) on Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE). (2005, revised in 2006): http://ec.europa.eu/environment/waste/weee/index_en.htm

EC Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive (2006).

EU RoHS Enforcement Authorities Informal Network, "RoHS Enforcement Guidance Document, Version 1" (2006).

IEC 62321 CDV "Electrotechnical products – Determination of levels of six regulated substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, poly brominated diphenyl ethers)" (2007).

IECQ QC 080000 Hazardous substance process management requirements, 2nd edition, International Electrotechnical Commission (2005): www.iecq.org.

Goldenharbour Co., Ltd., http://www.goldenharbour.com/StockList/NonFerrousMetalsAlloySteel.htm.

Haier: http://www.haier.com/cn/ (2005).

JGPSSI (Japan green procurement survey standardization initiative) Material Composition Survey And Response Manual, 3rd edition (2006).

Korea Eco Product Institute, http://www.koeco.or.kr/ (2007).

LG Electronics Co. Ltd., http://www.lge.co.kr/cokr/about/environ/purity_03.jsp# (2007).

Meiton Limited, http://www.meiton.com.hk/cgi-bin/product.cgi?action=product&language=&sortby= &menu=&part=1&page=1&.

Montgomery Research Inc., http://www.future-fab.com/documents.asp?d_ID=3044.

Murata Co., http://www.murata.com/info/rohs.html (2007).

Personal communication, Det Norske Veritas, Korea (2007).

Personal communication, Takao Sato of Ricoh Co. Ltd., Japan (2007).

Samsung Electro Mechanics (SEM) Co. Ltd., http://www.sem.samsung.co.kr/en/indexMain.jsp (2007).

Samsung Electronics Co. Ltd., http://www.sec.co.kr (2007).

Samsung Electronics CS Management Center, Eco-Partner Certificate Manual for RoHS (2004).

Storm Product Co. Ltd., http://www.stormcable.com/Uploads/Lead_Free_Cable_Compounds.pdf.

Thomas Publishing Co. Ltd., http://news.thomasnet.com/fullstory/13303.

Toshiba Corporation, "Guidelines for Green Procurement Ver. 05: No. 360045308 No. 501".

UK Government, "RoHS Regulations: Government Guidance Notes," Department for Business Enterprise And Regulatory Reform (2007): www.rohs.gov.uk.

The University of Bolton, http://www.ami.ac.uk/courses/topics/0135_cc/index.html.