



White Paper
Telecom and Compute Products

RoHS Compliance at Intel

Executive Summary

The Restriction of the Use of Certain Hazardous Substances (RoHS) Directive is a European Union (EU) directive that seeks to minimize the use of certain hazardous substances in electrical and electronic equipment (EEE). As a world leader in the EEE industry, Intel is committed to adhering to RoHS requirements. This white paper specifically addresses RoHS requirements as they pertain to Intel's telecommunication board and system-level products.

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Introduction

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive 2002/95/EC of the European Council and Parliament) was adopted by the European Union (EU) in 2003 to limit the amount of hazardous substances in electrical and electronic equipment (EEE). Although the RoHS Directive was intended to be implemented consistently by each member state of the EU, the RoHS Directive does not delineate a number of key issues, including

- Demonstration of compliance (labeling, testing, compliance certification, etc.)
- Enforcement (civil and criminal)
- Penalties (amount and nature)

Intel traditionally supports very high standards for protecting employees, customers, and the environment in its manufacturing processes and products and follows environmentally friendly corporate practices. (See the Environmental, Health, and Safety [EHS] Policy at <http://www.intel.com/intel/other/ehs/policy.htm>.) Therefore, it is a natural extension for Intel to take a proactive role in embracing the industry move to RoHS.

RoHS Defined

The RoHS Directive initially focuses on restricting the content of six specific substances.

- Cadmium (Cd)
- Hexavalent chromium (Cr [VI])
- Lead (Pb)
- Mercury (Hg)
- Polybrominated biphenyls (PBB)
- Polybrominated diphenyl ethers (PBDE)

The content limits for these substances are

- <0.01% Cd in homogeneous material
- <0.1% Cr (VI), Pb, Hg, PBB, PBDE in homogeneous material

Homogeneous material can be defined as material of uniform composition throughout that cannot be mechanically disjointed into different materials. Examples of such materials are plastics, ceramics, glass, metals, alloys, paper, board, resins, and coatings. "Mechanically disjointed" materials can, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding, and abrasive processes.

A semiconductor package contains many homogenous materials including plastic molding material, tin-electroplating coatings on a lead frame, lead frame alloy, and gold-bonding wires.

Lead is the RoHS restricted substance used most often in EEE. It completes viable electrical connections either in solders or between the semiconductor die-and-carrier within integrated circuit Flip Chip packages.

Intel is not alone in its use of RoHS-restricted substances such as lead in its EEE products; tens of thousands of EEE products sold throughout the world also use these restricted substances and are directly impacted by the RoHS Directive. Note that unlike the well-known dangers of lead contamination from previously used commodities such as leaded gasoline, paints, and plumbing devices, the risk of lead contamination from EEE is very small.

RoHS Terminology

This section discusses technology (first-level) and application (second-level) exemptions and abbreviations not included in the directive but commonly used in the industry.

Technology and Application Exemptions

If the RoHS Directive is applied in its entirety and all six substances are eliminated during device fabrication, certain technologies and critical applications may be adversely affected. Therefore, the directive includes exemptions in specific areas to mitigate negative impacts. Intel® telecommunications and compute products use exemptions that primarily fall into two categories: technology and application.

- **Technology exemptions** – typically used at the component level. Flip Chip or “die bump” technology is an example. This exemption uses leaded solder inside the component to interconnect the die to the device substrate, also known as a first-level interconnect (FLI). These exempted components have been approved for use across all applications.
- **Application exemptions** – cover the soldering of components to a printed circuit board (PCB) substrate using lead and creating an assembly in network, telecommunication, and server applications. The exemption of these second-level interconnects (SLI) permits the use of existing products not specifically designed for lead-free processes.

Abbreviations

RoHS 5/6 and RoHS 6/6 are abbreviations commonly used in the industry to designate components or products that comply with the RoHS Directive.

- **RoHS 5/6** – products contain lead used in an exempt application
- **RoHS 6/6** – products below the applicable RoHS Directive limits for all six substances without relying on any exemptions

Note that RoHS 5/6 and 6/6 have not been formally adopted by the EU Commission or by any recognized standards organization.

Intel’s RoHS Strategy for Telecom

Leaded solder is a proven and reliable means for securing components to boards. Because of the widespread use of leaded solder in component-to-board interconnections, telecom boards and system products contain significantly higher lead counts than products within Intel’s core silicon business. Although identifying technologies that work as well as lead in solder has proven difficult, Intel remains committed to adhering to the RoHS Directive and is investing in resources to ensure compliance for its telecom boards and system-level products.

Intel is working proactively with its suppliers, customers, and the EU. Although debate continues as to whether lead and other restricted substances in telecom equipment may impact human health or the environment, Intel is committed to reducing hazardous substances in its products.

Complying with the RoHS Directive is a major task, and Intel expects to follow these general rules:

- **PCI/CompactPCI* products** – are based on legacy designs and will initially be compliant, relying on the Telecommunications Exemption.
- **AdvancedTCA* products** – use a newer design and will typically be lead-free at the second-level interconnect.
- **Rack mount servers (RMS)** – are being converted for RoHS compliance.

For exceptions to these general rules, refer to the website at <http://www.intel.com/technology/silicon/leadfree.htm>.

In addition to testing, significant work is involved in converting legacy designs to RoHS compliance. In addition, all RoHS Directive exemptions (including the Telecommunications Exemption) will be revisited every four years by the EU. For this reason, Intel expects its efforts to convert products to comply with the RoHS Directive to be ongoing.

Additional Steps for Ensuring Compliance

Intel will not just be stating that its telecom boards and system-level products comply with the RoHS Directive; Intel is obtaining compliance declarations from suppliers and working to verify supplier statements and testing selected products to ensure that suppliers meet RoHS limits. At the same time, Intel is ensuring that product quality is not compromised.

Intel has a material content specification that it asks all suppliers to meet to ensure that its products are environmentally friendly and meet environmental requirements around the world.

This specification can be found at <http://supplier2.intel.com/EHS/environmental.htm>.

Intel is using a Material Declaration Datasheet (MDDS) to communicate that a product conforms to the RoHS Directive. (The MDDS is not required by the EU.) The MDDS incorporates supplier declarations and exemptions, as well as a material content analysis. Before Intel issues an MDDS statement, two steps must be completed to validate that the products are functionally equivalent and that they comply with the RoHS Directive. Sample MDDS statements can be found in the *Intel® Packaging Databook*, Chapter 17, found at <http://www.intel.com/design/packtech/packbook.htm>. Here are the two steps:

1. Supplier Declaration of Conformance

(SDoC) – Completing this document helps ensure compliance at the homogenous material level. Intel requests an SDoC for every component from each supplier as proof that the suppliers are providing RoHS-compliant components. Intel then reviews the SDoC to determine its completeness and accuracy, and requests test data as needed from suppliers. In the event that one or more supplier components do not conform, availability of an alternate drop-in replacement component will be determined. Check the *Intel Packaging Databook* (<http://www.intel.com/design/packtech/packbook.htm>) for more information

2. Grind Testing and/or X-Ray Fluorescence

(XRF) Testing – Although the EU Directive does not require it, Intel is conducting additional verification tests. An independent test lab performs a grind test on a sampling of boards representing a particular family. In the grind test, a spectral analysis is performed on the entire board. While the results of the test may not tell which component has a particular element, the test helps to verify that the SDoCs Intel receives are accurate, as well as documenting the amount of hazardous substances and their overall weight. (In its material decomposition list, the grind test includes materials above and beyond those

that are currently banned by the EU Directive.) In addition, XRF testing is done in-house on rack mount server chassis. This testing uses the physics of the interaction of gamma rays with electrons in the target element.

After the completion of these steps, Intel will issue an MDDS which will

- List the Item Market Name (IMN) and weight of the product.
- State the limits of the six hazardous substances defined by the EU in the product.
- Provide Intel's RoHS declaration(s) and exemption(s), including information from SDoCs and testing.
- Summarize the concentration of various elements from the grind test of either a particular board or a representative board in the same product family.

Availability of Compliant Products

Intel plans to release RoHS-compliant versions of telecom boards and system-level products as soon as they are converted and tested. RoHS-compliant versions of nearly all Intel® telecom boards and system products are expected to be available, but some exceptions based on current End of Life (EoL) plans, historical sales volumes, and projected customer demand may be made.

If an existing product is not converted to be compliant with the RoHS Directive, the non-compliant product may still be available for a period of time. The RoHS Directive only applies to EU member states; as such, the existing product can continue to be sold outside of the EU after the RoHS Directive is implemented. Also, non-compliant products can be sold in the EU as products outside the scope of the RoHS Directive (e.g., medical, measurement and control, and military equipment, spare parts for equipment on the market before July 1, 2006, or equipment [such as car radios] specifically designed for planes, boats, and other means of transport).

For current product plans for RoHS compliance, refer to the Intel Lead-Free/RoHS Compliant Product Search at <http://indigo.intel.com/leadfree/public/leadfreeproductsearch.aspx>.

Quality of Compliant Products

Intel is taking several steps to ensure that quality is not compromised in its RoHS-compliant telecom board and system-level products. These steps include testing, certification, and auditing.

Testing

Compliant product versions will undergo the same functional tests as previous Intel telecom board and system products.

In addition, Intel has built hundreds of production-level RoHS 6/6 product samples and is in the process of conducting extensive testing. Any customer who wishes to test RoHS 6/6 samples in the first half of 2006 can do so provided (1) feedback is regularly shared with Intel and (2) samples are available. To request a sample board, please contact your Intel account manager.

Certification

Two types of certification are planned:

- **Technology Process** – Certifies the technology and identifies the RoHS product design attributes and manufacturing processes that will yield consistent product quality. Intel has already ensured that its current key production contract manufacturers already have completed this certification.
- **Process Site** – Verifies that a manufacturing site has the capability to produce a RoHS-compliant product at an operational and process level. Again, Intel has ensured that its current key production contract manufacturers already have completed this certification.

Lead-Free Operations Audit Plan

Intel plans to verify that its facilities receiving products for repair, upgrade, or rework have the capability and logistics to process post-sales products in a lead-free environment. Periodic audits at these facilities will verify ongoing compliance.

RoHS in Other Countries

Though RoHS originated in Europe, other parts of the world have adopted, or are considering adopting, similar requirements. For instance, China adopted a “RoHS” statute, which is effective on or about March 1, 2007. Various other countries are considering legislation that would incorporate RoHS-like requirements (e.g., Australia, Argentina, Korea, Turkey, etc.). Japan recently adopted “RoHS” labeling requirements for certain products. In the United States, California has its own “RoHS” statute and rules that are effective on January 1, 2007; other states are considering or have recently adopted RoHS legislation.

Intel expects that the RoHS Directive will continue to evolve as it is implemented by countries within the EU and by other countries worldwide. As necessary, Intel will adjust its processes to changes in the RoHS Directive as required by EU enforcement and the internal decisions of Intel's corporate product ecology and legal teams. Because implementation and enforcement of the RoHS Directive may vary from country to country, updated information will be communicated as needed on the Intel website. While meeting the challenges of complying with these new rules and developing lead-free solutions, Intel also is providing technical assistance and education to governments considering lead-free regulations.

Other Directives

In addition to RoHS, the EU has published other environmental directives such as the Waste Electrical and Electronic Equipment (WEEE) Directive and the Energy-Using Product (EuP) Directive. While WEEE is not part of the RoHS Directive, it aims to restrict where and how EEE can be disposed of in Europe in an effort to preserve, protect, and improve the quality of the environment and human health. EuP is focused on reducing the energy requirements from a variety of EEE.

Acronyms

Cd	Cadmium
Cr (VI)	Hexavalent Chromium
EEE	Electrical and Electronic Equipment
EHS	Environmental, Health, and Safety [Policy]
EoL	End of Life
EU	European Union
EuP	Energy-Using Product [Directive]
FLI	First Level Interconnect
Hg	Mercury
IMN	Item Market Name
MDDS	Material Declaration Datasheet
MM	Material Master
Pb	Lead
PBB	Polybrominated Biphenyls
PBDE	Polybrominated Diphenyl Ethers
PCB	Printed Circuit Board
RMS	Rack Mount Servers
RoHS	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
RoHS 5/6	RoHS compliant with an approved exemption
RoHS 6/6	RoHS compliant for all six substances without relying on any exemptions
SDoC	Supplier Declaration of Conformance
SLI	Second Level Interconnect
WEEE	Waste Electrical and Electronic Equipment
XRF	X-Ray Fluorescence

For More Information

Intel Environmental, Health, and Safety

http://www.intel.com/intel/other/ehs/product_ecology/index.htm

Intel Lead-Free Solutions

<http://www.intel.com/technology/silicon/leadfree.htm>

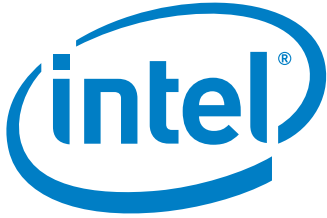
RoHS-Compliant Product Database

<http://indigo.intel.com/leadfree/public/leadfreeproductsearch.aspx>

Contains information for Pb-Free/RoHS compliant products that were initially offered in standard (non-lead-free) versions only.

RoHS FAQs

http://ec.europa.eu/comm/environment/waste/pdf/faq_weee.pdf



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