

Building an Effective Hazardous Materials Compliance System: Managing RoHS, WEEE and Other Regulations

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Introduction

In response to growing concerns about the effects of hazardous materials in the waste stream on the environment, the European Union (EU) passed a directive in 2002 entitled the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS). Even though RoHS is simple in scope and limits the use of only six substances, it nevertheless has created significant challenges for manufacturers trying to prepare for the day they must begin to comply with the directive on July 1, 2006.

Legislation such as RoHS and its sister ruling, the EU's Waste Electrical and Electronic Equipment (WEEE) directive, are forcing companies to examine not only how to ensure compliance but also how to manage information about the parts used in the manufacture of their electronic and electrical equipment. Until recently, most manufacturers didn't have to worry about parts information management and compliance. A recent study by Aberdeen Group revealed that less than one third of companies surveyed had standardized their product compliance practices across the organization.¹ In addition, at the time of the report, 80 percent of the surveyed organizations said that they lacked a cohesive systems infrastructure to track, audit or manage product compliance, while 75 percent admitted to not having audited product content in the previous six months.²

RoHS and WEEE aren't the only environmental regulations with which companies are required to comply. In the EU, the End of Life Vehicles (ELV) directive requires car producers to limit their use of hazardous substances in the manufacture of their cars while also increasing the amount of recycled components used in their products. It also makes car manufacturers responsible for the recycling of their products once they are no longer being used. Additionally, in the United States, environmental regulations are pending in a number of states. In California, the Electronic Waste Recycling Act of 2003, like RoHS and WEEE, seeks to establish a system for the reduction, collection and recycling of electronic product waste. The situation is similar in China, where the government has developed the Regulation for Pollution Control of Electronic Products (RPCEP). Unlike RoHS, however, RPCEP seeks to eliminate the six substances that the EU is trying to limit. Although legislation has not yet been enacted in Japan, the Japan Green Procurement Survey Standardization Initiative (JGPSSI) has collaborated with the Electronics Industry Alliance (EIA) to publish Joint Industry Guidelines for hazardous materials declaration.

As more countries continue to jump on the environmental bandwagon, it's becoming increasingly important for component manufacturers and Original Equipment Manufacturers (OEMs) alike to put in place the necessary infrastructure that allows them to track and manage parts data. Doing so will not only allow them to ensure compliance with RoHS, but will also help them comply with the host of other similar regulations they will undoubtedly be facing in the near future.

The Reality of RoHS

Despite the fact that RoHS seems to be getting a lot of coverage and interest, it's WEEE that started the ball rolling. The first major hazardous materials directive affecting electronics manufacturers in the EU, WEEE is designed to address the increasing amount of electrical and electronic equipment in the waste stream by making equipment "producers" responsible for the recycling of their products at the end of their life. This legislation was passed because the European Community was concerned that the amount of WEEE generated was growing rapidly and that waste management and recycling were insufficient. This concern is compounded by significant increases in the number of electronics equipment being manufactured and significantly shorter lifecycles for these products.

RoHS builds on WEEE, requiring manufacturers selling products in the EU to restrict use of six substances in their products: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers. The limitations discussed in the directive refer to the percentage by homogeneous weight of the substances existing in each of the components used in manufacturers' products.

RoHS is meant to apply to nearly all types of electrical and electronic equipment, but since its passage, there has been intense lobbying by special-interest groups to create exemptions for different industries and products. Some of the products covered by the exemptions include:

- Spare parts for electrical and electronic equipment placed on the market before July 1, 2006

- Products intended specifically for national security or military purposes Certain types of medical equipment
- Certain uses of lead, such as in network infrastructure equipment, which is exempt from the RoHS-mandated limitations until 2010
- The use of mercury in lamps and some types of lighting fixtures

Even though these exemptions are beneficial to some manufacturers, they also make RoHS more confusing for companies to adhere to. A part that is considered to be exempt because it is used in an exempt product can be considered to be non-compliant if it does not meet RoHS requirements and is used in a non-exempt product. In addition, the same product may be both exempt and non-exempt, depending on how it is used.

Despite this confusion, the responsibility for understanding the regulations and managing their parts accordingly rests with the company whose brand is on the product being sold into the EU. This holds true even if the company uses a contract manufacturer to build its products. While the EU has yet to force how companies should report compliance, it is still the responsibility of each company selling into the EU to ensure that their products meet the RoHS-mandated standards. One resource for compliance reporting is the Joint Industry Guide for Material Declaration developed collaboratively with EIA, EICTA and JGPSSI.

Table - Materials Restricted by RoHS

Restricted material	Uses for materials	Maximum limits under RoHS - amount measured by weight (parts per million)
Lead (Pb)	Attach solders, terminations, plating finishes	0.1% or 1,000 ppm
Mercury (Hg)	Relays, electrical switches, lamps	0.1% or 1,000 ppm
Cadmium (Cd)	Finish plating on metals	0.01% or 100 ppm
Hexavalent chromium (Cr VI)	Finish plating on metals	0.1% or 1,000 ppm
Polybrominated biphenyls (PBB)	Plastics flame retardant	0.1% or 1,000 ppm
Polybrominated diphenyl ethers (PBDE)	ABS, PP, HIPS, thermoset plastics, printed circuit boards (flame retardant)	0.1% or 1,000 ppm

Issues Associated With RoHS

While RoHS is admirable in its attempt to lessen the impact of hazardous materials on the environment, it is also putting pressure on organizations trying to comply with the directive. Some of the most pressing issues associated with RoHS include:

- Parts information management
- Replacement parts management
- Manufacturability

Parts Information Management

Many companies are now racing against time as they attempt to gather information on the parts in their products. After all, manufacturers may be selling hundreds, if not thousands, of products into the EU, each of which can consist of thousands of parts. And since a product's compliance depends upon the compliance of the individual components—or homogenous materials as the EU refers to them—companies can only determine if their products fulfill RoHS requirements by verifying that each and every component in each product is compliant. It can be a long and time-consuming process.

In order to access this information, companies are working closer with their suppliers. While large suppliers provide information on RoHS compliance for their parts on their websites, the data is often inconsistent from supplier to supplier and is difficult to find. On the other hand, smaller companies don't always publish this information and are therefore finding themselves inundated with requests for RoHS data. Since nearly every request is unique because manufacturers are often looking for different types and depths of information, it becomes more difficult for suppliers to respond to their customers. In the complex world of manufacturing, where companies often use contract manufacturers but are still responsible for ensuring RoHS compliance, their suppliers may not recognize the company requesting information as a customer, and are therefore less likely to respond. This adds layers of complexity in capturing and managing RoHS compliance information.

The implications of non-compliance are huge, affecting every department in the organization and all facets of the supply chain. Along with the RoHS directive's mandated penalties, companies can also face a significant loss of revenue and market share due to sales and export restrictions, marketing and public relations problems such as safety concerns and product recalls, and design and manufacturability issues associated with converting products to those that are perceived to be more environmentally friendly. These possible consequences must be weighed against the costs of compliance, including those associated with content and software solutions and changing design and manufacturing processes.²

Replacement Parts Management

In order for many companies to be compliant with RoHS, they need to find replacement parts for their non-compliant components. Suppliers are already responding to the directive by replacing their non-compliant parts with those that adhere to RoHS guidelines, but they often have different ways of distinguishing between the different part versions. Some are going to the effort of changing part numbers and are assigning new, RoHS-compliant replacement parts with unique identifiers. While this makes it easy for their customers to distinguish between the new compliant parts and the older non-compliant ones, it still requires manufacturers to go through the laborious process of changing their bills of materials (BOMs).

Commonly, Original Equipment Manufacturers, Contract Manufacturers or Original Design Manufacturers undergo an Engineering Change Order (ECO) for each item that needs to be changed in a BOM. The ECO process is revision control for everything from simple part number changes to changes in a part that have a significant impact on manufacturing. Even if ECOs are streamlined in the process, this adds time-consuming steps to achieve compliance.

Yet despite the short-term difficulties changing part numbers might cause, organizations such as the JEDEC Solid State Technology Association and the National Electronics Distributors Association (NEDA) are strongly advocating for suppliers to create unique part numbers for their lead-free and RoHS-compliant parts because part numbers that do not reflect changes in material composition can wreak havoc in manufacturing. JEDEC has issued guidelines on how suppliers can label and identify lead-free parts, which it defines as a part containing no more than 0.2 percent elemental lead. Despite this guidance, however, many suppliers still plan on relying on date stamps and product change notices to identify compliant parts and are telling their customers that those parts produced after a specific date meet the RoHS guidelines. Manufacturers are therefore responsible for tracking the different types of parts by date stamp in order to ensure that they are using the compliant versions.

Tin whiskering isn't the only concern companies have about their replacement parts. New components may help a company deliver RoHS-compliant products, but they can also affect assembly processes, such as soldering, which in turn can have a dramatic impact on their manufacturing yields. Even exempt companies and those not selling into the EU may be affected. As more suppliers render their non RoHS-compliant parts obsolete, all companies, whether they want to or not, will be forced to use RoHS-compliant components in their offerings and therefore need to learn how to handle the same manufacturability issues. This issue alone is creating tremendous additional obsolescence challenges for aerospace and defense contractors who want to keep the leaded components.

Building an Effective Hazmat Compliance System

Building and managing an effective compliance system that will help with ensuring RoHS compliance as well as meet future needs involves:

- Needs assessment
- Data capture
- Catalog management and integration
- Enterprise reporting and analysis
- Updating and maintenance

Manufacturability

While replacement parts allow manufacturers to reconfigure their products to meet the RoHS requirements, they can also affect how products operate. One of the biggest problems companies are facing is associated with the elimination of lead in their components. By substituting tin plating for lead finishes or eliminating lead from tin-lead plating, engineers are increasingly concerned that their parts will be subject to an engineering challenge known as tin whiskering, in which extrusions capable of shorting electrical circuits can form. It is believed that tin whiskering was the reason for the failure of the Galaxy 4 satellite in 1998—and now manufacturers predict the problem will continue to grow as lead is eliminated from solders.

While the RoHS directive is galvanizing a number of companies to start looking at how they manage their parts data, many

*leading organizations are using RoHS as a jumping-off point and are looking for long-term solutions rather than just short-term fixes. Aberdeen Group points out that market leaders often “... maintain a repository of regulatory, environmental, and operational compliance requirements, often relying on external information services firms to maintain currency. By contrast, average and lagging firms maintain compliance requirements in fragmented systems, if at all.”*²

Needs Assessment

In order to build a compliance system, companies first must objectively assess their needs. To do so, they need to be asking the right questions: Where are my products sold? What industries do I sell to? While these are basic questions, they highlight how important it is for companies to understand the regional and global regulations that will affect them. This also provides them with a foundation for quantifying exposure and measuring the positive impact of implementing a solution. After all, environmental regulations can change very quickly and often differ from region to region, country to country, and industry to industry.

Another important question organizations need to ask concerns the type of information they want to track. In other words: How do I want to manage my compliance? The answer to this question determines the level of information they need to gather—does a company just want to know if it is compliant with a specific regulation such as RoHS, or does it want to turn this situation into an opportunity to gather as much information as about its parts in order to better manage them throughout their lifecycle?

In order to be compliant with RoHS, for example, companies can elect to learn simply whether or not each component is compliant. This type of question is the simplest for suppliers to answer, but the resulting information may be too limited. Another option is to gather information about each of the six RoHS-limited substances present in each component, but even this type of data can be as simple as a yes/no response about whether each substance is at or above the threshold, or can be more comprehensive, providing the manufacturer with information about the exact concentration of each of the substances in each part. In addition, companies can choose to gather other information beyond what they need to ensure RoHS compliance, such as:

- Concentration of substances besides those limited by RoHS
- RoHS/WEEE-compliant replacement and equivalent parts information
- RoHS/WEEE compliance certifications
- Part lifecycle insight and information
- Logistical and inventory information

Data Capture

With thousands of components often used to build a single product, capturing data for an entire BOM can take a great deal of time. While some companies have responded to RoHS by hiring temporary workers to contact suppliers to gather the necessary information, they often underestimate how much time it will take for them to acquire the data. Temporary personnel may also lack the content management skill set that the process typically involves, such as knowing how to categorize, normalize and regularly update data. The end result can be a snapshot in time because the data cannot be sustained.

A second option is to outsource the data capture process but manage the resulting new information internally. Although this appears to be a viable solution because parts data is now structured, companies lose the ability to proactively respond to changes in parts after the time of capture, negatively affecting the ability to design compliant products with certainty in the future. Cases in point are those manufacturers declaring RoHS compliance or lead free status simply as a date change in a Product Change Notice (PCN).

Other companies have found that it is quicker and less expensive to outsource data capture activities to organizations that specialize in that type of work and have the resources to do it cost-effectively. Since the only risk associated with this option is the release of internal parts information to a third party, it remains of utmost importance that data is given to a trusted source for successful partnering. Those with highly skilled subject matter expertise, refined processes for collecting, aggregating, and structuring data, and who offer the flexibility to structure that information to fit within a company's internal systems structure are the best choices for partnering.

Catalog Management and Integration

Managing the gathered data is vital to not only ensuring compliance with existing products but also to developing new products that are compliant from the start. The goal of catalog management and integration is to organize the data into a format that is easy to search. In its report on designing compliance systems, Aberdeen Group writes, “Ensuring product compliance requires enterprises to establish a common information technology and application infrastructure to function as the central nervous system for all product information management and development activities. This information

infrastructure should incorporate data management, visualization, collaboration, and project management capabilities, including pre-defined alerts and reports to track and respond to regulatory requirements and other compliance initiatives.”⁴

It is estimated that 80% of the costs in a product’s lifecycle are determined in the design phase. With the right catalog system, companies can create integrated decision support for design for compliance, part specification, component standardization and design reuse. As shown in Figure 1, the catalog management system should serve as a platform through which data from external reference content along with other external systems and internal enterprise systems such as product data management, supplier relationship management, enterprise resource management and supply chain management systems can be easily incorporated into the engineering design and decision-making process.

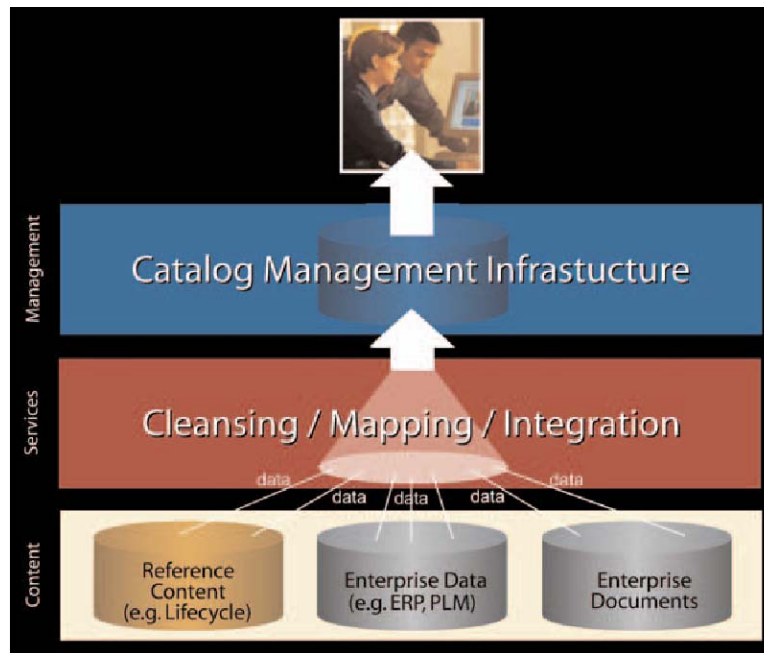


Figure 1 – Integrated Ties between Content, Services, Catalog Management, Retrieval, and Reporting Systems

Enterprise Reporting and Analysis

While the EU and its member countries have yet to standardize how organizations need to report their compliance with RoHS and WEEE, it is inevitable that any company trying to operate in the region will have to find an organized way to demonstrate compliance and respond to any audits. Suggested approaches to material declaration such as IPC-1752 and Joint Industry Guides (JIG) A & B have been introduced to address the problem by allowing both customers and suppliers to exchange compliance data in a recognized format. At present, there is no standardized reporting template that has been adopted by all EU countries. Therefore, companies need flexible reporting tools that can generate reports in formats required by each of the countries in which they are selling their products.

Even if a country accepts a company’s products, they may decide to audit. Having an accurate and complete paper trail that supports compliance becomes critical in order to avoid penalties associated with non-compliance.

Since regulations will continue to evolve, a company’s system should also allow them to easily monitor and analyze their compliance with existing and emerging regulations, so that they can continue to cost-effectively ensure compliance and adapt with the regulations that affect them.

Updating and Maintenance

Data, in and of itself, drastically loses its value over a very short period of time. In order to remain useful, parts management and compliance systems need to be proactively managed and kept up to date. Since parts data is continually changing, companies require a way to continuously update their systems with these critical changes. These changes have to be effectively communicated to all aspects of the organization, from engineering through manufacturing. By having the systems and processes in place and up to date, companies will be better able to identify and quickly react to new regulations that require them to gather different types of information.

Conclusion

For many companies, RoHS and WEEE represent only the beginning of a new, permanent trend. With concerns over the

impact of products and commerce on the environment continuing to grow, open borders leading to the increasing import and export of goods, and shorter product lifecycles, companies will find themselves bombarded by the forces of legislation that will impact how they design, sell and recycle their products. Current internal asset management systems and design tools are not designed to support rapidly changing information. Yet it does not make sense for companies to invest heavily in taking on data management internally, since it simply does not fit with core competencies in manufacturing excellence. By conducting an effective assessment of their current situation, investing in the right infrastructure, and finding a trusted data capture and management partner, successful companies will not only help ensure compliance with current and future regulations, but will also enable increased responsiveness to prevailing customer and

References

1. "The Design for Compliance Benchmark Report: Leading Compliance with Product Design," Aberdeen Group, November 2004.
2. ibid