

the **EXTENSION**

A Technical Supplement to Control Network

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Realities of RoHS Compliance

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Introduction

The July 1, 2006 deadline for meeting the requirements of the European Union's Restriction of Hazardous Waste (RoHS) Directive has now passed. Electrical and Electronic Equipment (EEE) placed into the community falls under compliance of this directive. Producers of these products are allowed to self-declare compliance to the directive, but they must have a system in place demonstrating that the proper due diligence was pursued.

For companies such as Contemporary Controls, the major issue is lead solder. In order to attain compliance, Contemporary Controls had to convert to lead-free production. Each component listed in a finished good bill-of-material was reviewed for RoHS compliance, and part substitutions were made when non-compliance was identified. For those items that could not be converted, the product was dropped from future production or stock was built to meet upcoming customer requirements. Although the process line has been converted and all designs have been reviewed for lead-free compliance, there is still not an ample amount of lead-free inventory to meet demand. Some lead-free components are not readily available as suppliers attempt to deplete their leaded stock. Some customers have no interest in lead-free products while others are claiming exemptions to the RoHS Directive. This paper discusses the issues with converting over to lead-free production and the company's plan to demonstrate due diligence in complying with the directive's requirements. Exemptions to the directive will be reviewed along with the company's plans to support existing customers with legacy leaded-products.

Background

The European Parliament and the Council of the European Union (EU) has issued directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Member states shall ensure that, from July 1, 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). Maximum concentration levels (MCV) are 0.1% by weight (0.01% for cadmium) in homogeneous materials. A homogeneous material is a single substance. Therefore, components are not homogeneous substances since they are composed of several materials each with the potential of containing the banned substances. All components within a product must

be examined to ensure that no banned substances exist in order to meet this directive.

A second directive, 2002/96/EC, deals with waste electrical and electronic equipment (WEEE). It seeks the prevention of waste electrical and electronic equipment, and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce waste disposal. Both directives will have a significant impact on Contemporary Controls' operations and future business.

Although the European market is large, it is not the only one in which Contemporary Controls participates. The company continues to produce leaded and lead-free products to various markets worldwide. However, other countries are following the EU initiatives, and will soon develop similar restrictions. The company's intention is to eventually convert all production over to lead-free. It is simply too difficult to maintain both a leaded line and a lead-free line with the inherent risk of contamination to the lead-free line. However, during this conversion period the company needs to continue to support its customers, and issues remain.

Not all the company's customers want or need lead-free products. Some customers are insisting that the products they purchase should not be changed. In addition, there are exemptions to the RoHS Directive allowing for leaded products to continue to be sold in Europe. Contemporary Controls has always prided itself in supporting its customers by providing products beyond a normal life-cycle. Some of the company's products are over 20 years old and lead-free substitutes do not exist. This is part of the challenge in converting to lead-free.

Company Overview

Contemporary Controls designs and manufactures industrial networking equipment that facilitates communication between computers, controllers, sensors, and actuators in automation applications. Products include hubs, switches, media converters, routers, gateways, and network adapters. Three technologies are supported. The ARC Control® line is compliant to the ARCNET real-time network. The CTRLink® line represents the company's newer Industrial Ethernet products. The Controller Area Network (CAN) line represents products that include technology such as the company's Extend-A-Bus® bus extender. These products are found in diverse industries such as glass making, transportation, power generation, environmental control, and medical.

The nature of these products is such that, by themselves, they cannot implement an automation project. They are used to facilitate a project, and therefore, the company seldom sells to end-users. The vast majority of the sales are to system integrators, distributors, and original equipment manufacturers (OEM). The final location or application of the company's products is not usually known by Contemporary Controls.

The company's products are manufactured at Contemporary Control Systems, Inc. (CCSI) in the United States or Contemporary Controls (Suzhou) Co. Ltd. (CCC) in China. There are two subsidiaries in Europe. Contemporary Controls Ltd (CCL) operates as a master distributor serving the United Kingdom (UK) and other portions of Europe. Contemporary Controls GmbH (CCG) is also a master distributor serving mainly German-speaking countries within Europe.

Interpreting the RoHS and WEEE Directives

The RoHS and WEEE Directives are not long to read, but comprehension is another issue. The company relies upon experts in the field and guidance documents from government agencies. Much of what the company has learned came from two documents. The Department of Trade and Industry (DTI) in the United Kingdom authored *RoHS Regulations—Government Guidance Notes* in November of 2005. In May 2006, the *RoHS Enforcement Guidance Document* was produced. The first step is to learn the equipment categories covered in the directives. The WEEE Directive lists the equipment, but there is no mention of them in the RoHS Directive. However, the guidance documents suggest that the WEEE list can be used with the RoHS Directive.

Categories of Electrical and Electronic Equipment

In Annex IA of the WEEE Directive, ten categories of electrical and electronic equipment are listed. They are shown in Table 1.

Table 1: EEE Categories
1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (except large tools)
7. Toys, leisure and sports equipment
8. Medical devices *
9. Monitoring and control instruments *
10. Automatic dispensers

* Not covered by RoHS Directive

In Annex IB, specific types of products are listed under the major categories. By examining the two lists, the company

has identified several potential areas under which Contemporary Controls' products may apply.

Although no hub, switch, media converter, router, gateway, or network adapter products are listed under category 3 (IT equipment), it is possible to say that the company's products could be classified under "other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means." Certainly, these products provide "communication of information by electronic means." The hub, switch, media converter, router and gateway products are stand-alone products that receive external power and begin functioning when connections are made. The network adapters are different in that they must be inserted into another piece of equipment in order to function. The ten category listing of products identify end-user products. They do not specifically address devices used to support these end-user products. For example, the company's products are used in applications found under category 8 (Medical) and category 9 (Monitoring and control instruments). It is also possible to find the company's products in large stationary tools which are exempt from category 6 (Electrical and electronic tools). All of these application areas are exempt from the RoHS Directive. Therefore, we need to study the exemptions closer.

Exemptions to the RoHS Directive

The DTI documents provide good guidance on the exemptions. Some exemptions only provide short-term relief, but they can be helpful as the industry struggles to achieve RoHS compliance. For most products, it is quite clear whether or not the product falls under the scope of the directive. However, for specialty industrial products it remains unclear. Contemporary Controls' products are a good example.

Of the ten categories of products listed under the WEEE Directive, only eight fall under the scope of the RoHS Directive. The Medical and the Monitoring and Control categories are exempt. These are two areas where Contemporary Controls' products are used. In fact, under Annex IB in the WEEE Directive, examples of monitoring and control equipment includes "other monitoring and control instruments used in industrial installations (e.g. in control panels)." All of Contemporary Controls' products, except for network adapters which mount into other equipment, are intended to be mounted in control panels. Network adapters installed in industrial controllers could then be mounted in control panels. Other guidance has been provided on the subject.

If the equipment in question is part of another type of equipment which is exempt, then the parts that make up the exempt equipment is also exempt. For example, if a Contemporary Controls' product is used in a monitoring or control application, the product would be exempt from both the RoHS and WEEE Directives.

The concept of the "fixed installation" was addressed. A fixed installation may be a combination of several

pieces of equipment assembled together by a professional assembler at a particular location to perform a specific task.

Since this installation is not being put on the market as a single commercial unit, it is exempt from the RoHS and WEEE Directives. In most automation projects, the intent is to improve a system's productivity within a customer's plant, factory or process line. There is no intent to market the automation system as a single commercial unit. Therefore, a Contemporary Controls' product used in an automation application is exempt from the directives. The same can be said of "large stationary tools" which are exempt from category 6. Because they represent a fixed installation, they and their component parts are exempt from the RoHS and WEEE Directives. The guidance document expands the fixed installation definition to include "a machine or system, consisting of a combination of equipment, systems, products and/or components, each of which is designed, manufactured and intended to be used only in fixed industrial applications." These types of systems are exempt and therefore the components in them are exempt.

Another key exemption relates to spare parts and the expansion of an existing system. This typically occurs when industrial networks are expanded in the field. This situation has applicability especially with the company's mature ARC Control product line with its numerous customer installations. Expansion boards for the company's chassis hubs are still available for enlarging an existing installation. Spare parts, replacement parts, and parts to expand existing installations are also exempt from the RoHS Directive. This is important since some of the ARCNET components are not available lead-free and yet customers intend to enlarge their systems.

Finally, there is the issue of category 3 (IT and telecommunications equipment). End items (the company calls them end stations) such as personal computers, printers, fax machines, telephones, and other such devices are included in the scope of the RoHS Directive. Those items that support network infrastructure are not included in the RoHS Directive. This is interpreted to mean hubs, switches, media converters, routers, and gateways.

From the above decision, it would appear that Contemporary Controls' products are exempt from the RoHS Directive. However, the company's position is that the customer must decide if RoHS compliance is required. The company's products can be applied in numerous ways, and how it is applied determines if RoHS compliance is a requirement. A customer may insist upon a lead-free product in order to meet the needs of his own "green" initiative and Contemporary Controls hopes to comply with the request. Other customers may accept either a leaded or lead-free product or insist upon leaded products. They are the responsibility of the customer to make the best informed decision as to compliance requirements. It is Contemporary Controls' responsibility to ensure that a

product marked as "RoHS Compliant" is indeed RoHS compliant. This is where due diligence comes in.

Documenting RoHS Compliance

There are no stated documentation requirements in the RoHS Directive. After July 1, 2006 products are presumed compliant. Providing a Material Declaration document attesting to RoHS compliance for each finished good being sold is not sufficient. A Technical Compliance File (TCF) must exist to prove that the manufacturer has done the required due diligence that ensures that the product being sold meets the requirements of the directive. Although experts in this area have made recommendations, there are no specific requirements of the TCF. One of those recommendations is to verify that the data being retained in the file can be audited.

The RoHS Enforcement Guidance Document is helpful in stating what is expected from a manufacturer who self-declares compliance. Although the document clearly states that the information provided is informative and advisory, but has no legal authority, it does help our company understand the direction the UK is taking in enforcing the directive. The UK is only one member of the EU and what is being proposed applies only to the UK. However, the hope is that other member states will choose to follow the direction set by the DTI. The intent of their document is to both assist member states with national enforcement and to provide clarity to the industry on how producers can demonstrate compliance. According to the directive, a producer is the manufacturer that sells equipment under its own brand or resells other people's equipment under its own brand. Contemporary Controls has elected to develop a *RoHS Compliance Documentation System* based upon recommendations in this document.

The document supports the notion of *Presumption of Conformity*. Equipment falling under the scope of the directive and first placed on the market after July 1, 2006 is assumed to comply with the directive. Producers of this equipment are allowed to self-declare their compliance to the directive. There are two possible self-declaration approaches, both of which are based upon the resources of the affected organization. Large companies are assumed to have comprehensive quality management systems in place so they are to follow approach A which is called *Process-based Technical Documentation*. Compliance is ensured due to effective internal systems. For small to medium-sized enterprises (SMEs), approach B is acceptable. This approach is called the *Product/Part-based Technical Documentation* which relies upon the physical attributes of the product's components that ensures compliance. Contemporary Controls is pursuing approach B.

Using Approach B

The company is first required to provide some overall documentation as part of its document plan. The company needs to list the RoHS compliance person, information about the size of the organization, the company's

approach to compliance, and an overview of quality systems that are in place.

The above information is required if the company is pursuing approach A or B.

The next level of documentation is specific to the approach being taken. For approach B, the company needs to provide the following documentation listed as points 7, 8, 9 and 10.

7. The company's Certificate of Compliance declaring that the finished good being put on the market has restricted substances within permitted limits.

8. Completed material declarations from suppliers for each component used in the finished good. These declarations only need to state the level of banned substances.

9. Analysis reports of homogeneous materials of components used in the finished good. The tests can be conducted internally or externally.

10. Evidence that procedures are being followed to ensure that material declarations are being obtained and that suppliers are being assessed as to their reliability. The procedures themselves need to be made available.

From a practical point of view, it would be best to obtain material declarations from each component supplier since testing homogeneous materials is both expensive and impractical. These declarations would need to be retained in the Technical Compliance File. The reliability of the vendor needs to be questioned. It is important that the information being supplied is believable. These material declarations must come from the original manufacturer and not from a vendor. The industry is still struggling with a common material declarations form. However, Contemporary Controls has chosen to use IPC-1752-1 from the Association Connecting Electronics Industries (IPC).

RoHS Due Diligence Plan

As mentioned before, material declaration is only part of the story. The company needs to ensure that RoHS compliance will continually be met. What follows is a ten point plan Contemporary Controls has developed to ensure on-going compliance.

RoHS Compliance Plan

1. Identify Banned Substances. All components within each bill-of-material have been reviewed for banned substances and when necessary, component substitutions have been made. Legacy finished goods that cannot be converted to lead-free have been identified.

2. Get the Lead Out! The former leaded line has been converted over to lead-free by replacing the reflow oven and outfitting the wave soldering line for lead-free production. The leaded solder bath was drained, and refilled with SAC305 lead-free solder. Leaded solder paste has been replaced with lead-free paste.

3. Segregate the Factory. Leaded and un-leaded inventory has been segregated, and a RoHS finished goods warehouse has been created. Separate rework stations have been established for leaded rework and un-leaded rework. Leaded and un-leaded processing areas have been designated.

4. Specify RoHS Components. Only RoHS compliant (or RoHS exempted) components, substances, plating, and processes are specified. Printed circuit boards will be either copper-only or silver-plated. Material declarations are obtained from manufactures and stored in Technical Compliance Files.

5. Purchase RoHS Components. The Purchasing department reinforces engineering specifications by stating on purchase orders that only RoHS or RoHS exempted components will be accepted. Suppliers are identified as to their level of risk in being able to continually supply RoHS compliant components.

6. Receiving RoHS Components. The Receiving department inspects, accepts and stores RoHS components in assigned locations in the main warehouse. Non-RoHS compliant components will be rejected.

7. Verify Process Integrity. The composition of the solder bath will be analyzed every quarter by an outside firm for proper levels of silver, copper and tin. Calculated refills will be made to rebalance the bath. The lead content will be monitored so as to be within acceptable limits.

8. Label RoHS Compliant Products. RoHS compliant finished goods will be identified both on the serial number label and on the shipping container. Non-marked products should be assumed as composition unknown.

9. Audit RoHS Processes and Procedures. Conduct internal audits to verify that established RoHS compliance procedures are being followed. Monitor supplier performance on delivering RoHS compliant components. Review solder bath analysis reports.

10. Communicate with Customers. Ensure that customer requirements are understood and that customers are aware of the composition of the company's products being purchased. Maintain Material Composition Declarations on the company's web site.

References

RoHS Regulations—Government Guidance Notes, Department of Trade and Industry, November 2006

RoHS Enforcement Guidance Document, Department of Trade and Industry, Version 1, May2006

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