



*Working to make  
Massachusetts a safer  
place to live and work*

**tyco**

*Electronics*

**M/A-COM**

## **M/A-COM's RoHS Initiatives**

*Prepared by the M/A-COM RoHS Team  
Lowell, Massachusetts  
May 2006*

### **Introduction**

M/A-COM, Inc., a business unit of Tyco Electronics, is an established industry leader in the design, development and manufacture of radio frequency (RF), microwave and millimeter wave semiconductors, components and technologies for the wireless telecommunications, automotive, aerospace and military industries. Holding hundreds of patents in the field, M/A-COM is internationally known as an innovator and integrator whose technologies are found in some of today's most advanced signal intelligence and defense systems, as well as in leading automotive navigation, safety, and communications solutions. M/A-COM is also a major supplier of critical communications systems and equipment for public safety, utility, federal and select commercial markets. Headquartered in Lowell, Massachusetts, M/A-COM has offices and manufacturing facilities worldwide.

M/A-COM is committed to conducting its business in an environmentally responsible manner that protects the environment and provides an atmosphere for continuous business growth and development. Fulfilling its responsibility to protect the environment enhances M/A-COM's ability to provide competitive and profitable products and services. As an ISO9001: 2000 and ISO14001 registered-company, M/A-COM and its businesses worldwide commit to:

- Conduct operations around the globe in a manner that protects the environment, employees, and neighbors;
- Comply with all laws, regulations and permits applicable to products and operations, and comply with its own more stringent standards whenever necessary;
- Apply pollution prevention and design for the environment principals to cost-effectively reduce the environmental impacts of manufacturing processes and products;
- Manage resources responsibly, conserving as well as protecting the environment;
- Maintain a comprehensive environmental management system to implement this policy and to ensure continual improvement;
- Establish and then regularly review and measure environmental objectives and targets; and
- Work in partnership with the government and the public in the development of responsible and effective environmental laws, regulations and standards.

On January 27, 2003, legislation was enacted in Europe (Directive 2002/95/EC) restricting the use of certain hazardous materials in electrical and electronic equipments placed on the market after July 1, 2006. This Restriction on the use of certain Hazardous Substances (RoHS) Directive limits the amount of six environmentally hazardous substances allowed in electrical and electronic equipment, including:

- Four heavy metals: lead (Pb); mercury (Hg); cadmium (Cd); hexavalent chromium (Cr+6), and
- Two classes of flame retardants: polybrominated biphenyls (PBB); and polybrominated diphenyl ethers (PBDE).

Establishing a goal of complying with this European Union (EU) Directive was a logical step for M/A-COM as it operates its business according to the strategic commitments itemized above.

## Corporate Objectives and Management Structure

M/A-COM made a commitment in 2003 to properly manage the requirements of the European RoHS Directive through the creation of a cross-functional oversight team with Senior Management representation included. In addition, every M/A-COM manufacturing location designated a site coordinator. Reporting to the site coordinator was a local cross-functional team. The composition of the RoHS oversight team is illustrated in Figure 1.

**Figure 1 – M/A-COM RoHS Oversight Team Structure**

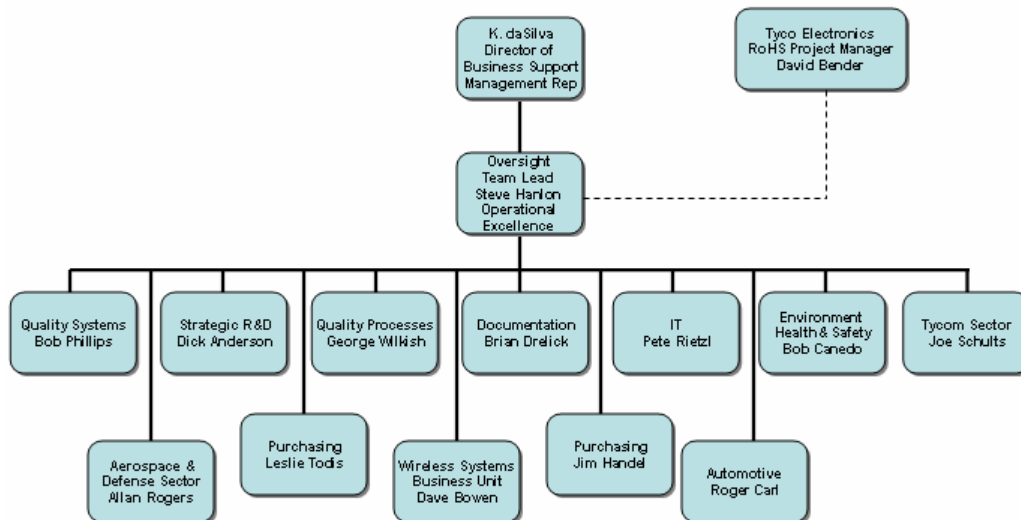
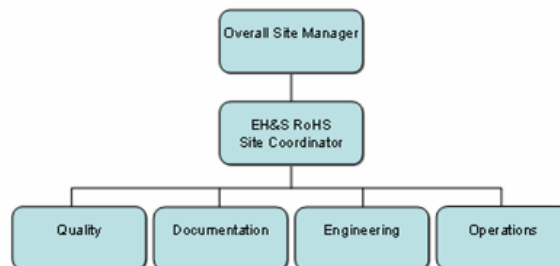


Figure 2 illustrates a typical local cross-functional RoHS compliance team structure.

**Figure 2 - M/A-COM RoHS Cross-Functional Local Team Structure**



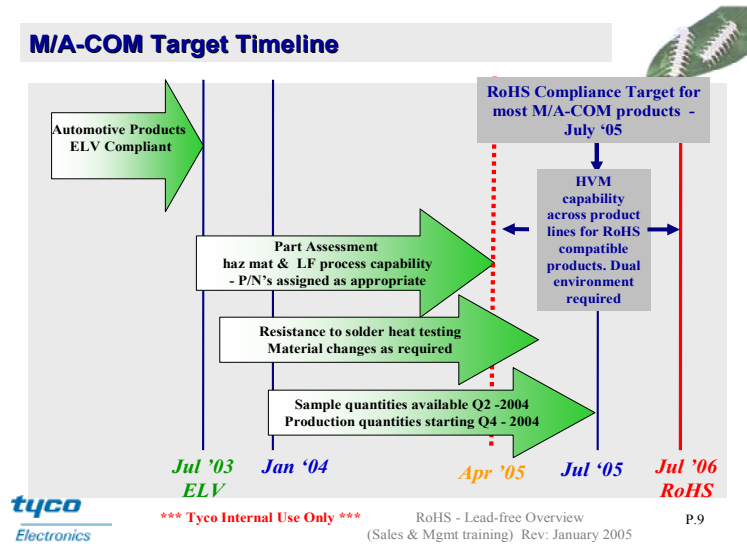
M/A-COM's management directive was to comply with the RoHS Directive well before the July 1, 2006 deadline. M/A-COM also decided that both compliant and non-compliant versions of parts would be supported where it made business sense. Additionally, M/A-COM wanted to ensure that this project could be achieved with no new short or long term additional personnel and with systems that

would ensure long term continued compliance. Lastly, the success of this program was dependent upon the involvement and ownership of all disciplines throughout the corporation.

## Overarching Management Decisions

M/A-COM decided early on that, due to logistical reasons, the best approach to achieving RoHS compliance while continuing to satisfy its varied customer needs was to issue a completely new M/A-COM part number when creating a RoHS version of an existing part. By far, most customers required or preferred a new part number for the RoHS compliant version. For similar reasons, the use of a prefix or suffix such as LF was ruled out. An edict from Senior Management was sent out to all M/A-COM facilities requiring compliance to the new part numbering requirement.

The fundamental approach to the RoHS transition strategy was to qualify product families rather than qualify an individual part number. M/A-COM's goal was to be RoHS compliant for most product families by July 2005, as depicted in the timeline to the right. It was critical to M/A-COM to produce RoHS compliant products without compromising form, fit or function and that performance and reliability meet or exceed that of current products. Once a product family was qualified as compliant and compatible to RoHS, all subsequent products in that product family were deemed qualified by similarity.



To ensure support throughout the company, a policy statement signed by all Senior Management supporting the efforts of the oversight team and site-specific teams was issued. Again, to raise awareness and support, an internal website was created. This website (see screen shot of the website's first page below) provides information on system changes, organization charts, customer forms, inspections, the timeline, qualification reports, customer inquiries and division policies.



# Major Engineering & Quality Milestones in Making M/A-COM Products RoHS Compliant

Several major engineering and quality milestones were realized as part of the RoHS conversion project, including: 1) development of a comprehensive qualification process document entitled REL-205; 2) replacement of hexavalent chromium coatings; 3) cross contamination prevention; 4) mitigation of tin whiskers; 5) manufacturing process changes; and 6) part coding.

## 1) Qualification Process Document, REL-205

Realizing in early 2003 that there was much confusion among customers and the industry about which tests to perform for RoHS qualification, and facing the need to move forward with testing nearly 50 product families, a team was formed to develop an internal RoHS qualification guideline. This document (REL-205) guides the design and quality engineers through a progression of steps that will ensure proper reliability and environmental testing.

The REL-205 document was primarily written to address quality issues associated with plastic integrated circuit (IC) type components such as surface mount technology (SMT), ball grid array (BGA), leaded components, and Pb-free plated components, but it also addresses cover assemblies and plating material testing. This document describes a number of tests that should be used to validate or qualify RoHS compliant products.

Test guidance in REL-205 is presented in groups based on common issues or challenges associated with various material components or assemblies. As an example, some issues for plastic IC parts are:

- a) Group A addresses primary concern for the plastic package or overmold/substrate (device example: SOIC, Multichip, Hybrids). Common problems are pop corning and package delaminating. Leads may be Pb-bearing and used in a Pb-free process (e.g., higher temperature SMT reflows) or leads may be Pb-free.
- b) Group B addresses primary concern for plating issues on leads such as tin or Pb-free plating (examples: SOIC leads, plastic package leads, gold plated leads). Common problems are tin whisker and solderability issues/failures.
- c) Group C addresses primary concern for Pb-free solder/joint issues (examples: BGA/Land Grid Array/SMT with Pb-free solder). Common problems are fatigue, fracture, and solderability issues/failures.

Some example of compliant tests for plastic ICs are provided in the Appendix. A process flow card provides the reliability procedure for implementing these tests.

## 2) Tri-Chromate Plating (TCP) Qualification

Hexavalent chromium is used as a corrosion inhibitor and primer for paint and coating adhesion in many industries. It is easy to apply and is inexpensive. Unfortunately it is also an occupational health hazard, classified as a carcinogen and mutagen. M/A-COM mandated that suitable, effective replacements for hexavalent chromium coatings be found wherever possible for environmental, health, and economic reasons.

For its replacement, M/A-COM chose a trivalent chromium coating (TCP) and application process patented by the United States Navy. When properly applied to aluminum TCP meets or exceeds many military and ASTM specifications, and is more benign to health and the environment. It can also be highly effective on zinc surfaces.

The US Navy has licensed TCP processes to a number of commercial chemical manufacturers. M/A-COM is currently in the process of qualifying TCP coating suppliers through a joint effort with METALAST International, Inc. One local supplier has been successfully qualified to date and qualification of other US suppliers is underway. Wherever possible, M/A-COM will replace hexavalent chromium with TCP.

### 3) Cross Contamination Prevention

It is not enough to design a RoHS compliant product. You now need to prevent cross contamination through out the whole business. This means that an audit of the whole process from receiving and inspection, stock room, kitting, manufacturing floor, QA, final pack and ship must be completed.

A cross functional team was created specifically to look into this issue. The team audited all of the above areas for our main facility in Lowell and is in the process of completing the audits for all the satellite manufacturing sites. Areas of concern include common tooling and equipment, floor stock, signage, etc. Even with all of these precautions, operator education is a must.

### 4) Tin Whisker Mitigation

M/A-COM has more than 10 years experience producing lead-free electronic modules using higher melting point RoHS compliant solders. M/A-COM is using this expertise to produce RoHS compliant and compatible parts and assemblies for use throughout the industry.

As a result of the new Pb-free requirements imposed by RoHS and other environmental directives, such as the EU End-of-Life Vehicle Directive, MA/COM has converted to using 100% tin as the most cost-effective, drop-in replacement finish for electronic parts and circuit boards. Pure tin, under certain conditions, can grow filaments called “whiskers” that can bridge leads and cause short-circuit failures. Previously, a tin finish containing the banned metal, lead, was used because lead inhibits whisker growth.

A number of studies by industry-government-academic consortia, including several with Tyco Electronics as a member, have determined test methods capable of predicting the tendency for specific tin finishes to grow whiskers and, using these methods, have also determined mitigation techniques to inhibit the growth of whiskers in tin finishes. Approved standards and specifications based on these methods are now in place.

M/A-COM, in cooperation with all of Tyco Electronics and its suppliers, has addressed the tin whisker issue in three ways. In all cases testing and documentation is required to ensure specifications are met.

- 1) Initial whisker mitigation efforts focused on modifying the 100% tin finish to inhibit the size, number and growth rate of whiskers. Such finishes are called “matte tin” due to the resulting roughened surface. Tyco Electronics has tested numerous plating systems and other 100% tin

finishes identifying and specifying those finishes (and pre- and post- application treatments) that meet whisker mitigation criteria.

2) Where 100% matte tin finishes are used, the most effective mitigation treatments include either: a) nickel barrier under-plating to prevent the formation of copper-tin intermetallic layers shown to enhance whisker growth tendencies, or b) a post-tin application heat treatment at 150 °C for 1 hour, performed within a specified time limit after applying the tin. One of these treatments is specified in all cases.

3) Replacing 100% tin with compliant and effective alternatives, where feasible and cost effective, is also employed. Numerous studies have shown that replacing tin on component terminations with a nickel-palladium-gold finish results in a cost-effective, solderable surface that has never been shown to form whiskers. For circuit board finishes, electroless nickel - immersion gold (ENIG) is a highly solderable finish that does not exhibit whisker growth, is cost effective, and has a long shelf-life when stored properly. Other “Whisker Inhibited” finishes are also effective.

### 5) Manufacturing Process Changes

As part of the RoHS readiness reviews, the entire manufacturing process needed to be analyzed. During this analysis, M/A-COM identified that solder compositions needed to be changed and new reflow profiles were required for the surface mount reflow and wave soldering. All tin lead solders were replaced with high temperature SAC305 or SN100 alloys. Through careful experimentation, specific profiles were identified and catalogued that provide proper wetting while ensuring no damage to the assembly from high temperatures during processing.

M/A-COM offers both the non-compliant RoHS and compliant RoHS products to meet customer needs. As with all manufacturing process changes, in accordance with ISO:9001 2000, all operators and inspectors needed to be retrained to the requirements of IPC-A-610D. Also, appropriate manufacturing work instructions were updated where required.

### 6) Part Coding

M/A-COM presently has over 220,000 part numbers in its database. Today, every piece part, sub-assembly and finished good part number is identified with a RoHS/ELV compliance code (Table 1)

**Table 1: RoHS/ELV Code**

<b>Code Letter</b>	<b>Explanation</b>
A	Converted to Directive 2000/53/EC ELV compliant (running change – same part number) <sup>1</sup>
Y	Converted to Directive 2002/95/EC RoHS compliant (running change – same part number)
E	Always Directive 2000/53/EC ELV compliant (not impacted and new parts) <sup>1</sup>
R	Always Directive 2002/95/EC RoHS compliant (not impacted and new parts)
L	Contains lead or other hazardous materials (not compliant)
S	Not in scope of Directive 2000/53/EC ELV
T	Not in scope of Directive 2002/95/EC RoHS
U	Not in scope of ELV and RoHS
N	Not yet reviewed

<sup>1</sup> The distinction between always compliant or changed is required for Mil-Aero to determine what may be shipped. Addresses part status change after 1 January 2003, so parts converted prior to 1 January 2003 should be coded as “Always Compliant.”

and a processing code. Periodically, all Bills of Materials (BOMs) are computer analyzed to ensure consistency. That is, if a piece part in a sub-assembly is coded non-compliant while the sub-assembly is coded compliant, this inconsistent relationship is highlighted and resolved accordingly.

It is extremely important to note how critical the part coding effort is to M/A-COM. The RoHS/ELV code in the Matrix Product Data Management (PDM) system drives all other applicable system functions within our Enterprise Resource Planning (ERP) system. This includes customer labeling and packaging, purchasing warnings, incoming label generation, certificate of compliances and customer service support.

## **Purchasing and Supplier Support Efforts**

### **Purchasing System Enhancements**

RoHS functionality has been built into the purchasing module of SAP, M/A-COM's ERP system, to help ensure that we purchase compliant material. Requisitioners and buyers are each guided through the purchasing transactions via a series of pop-up messages triggered by the RoHS compliance part code. In addition, SAP will prevent material that has not yet been coded with a RoHS compliance code from being ordered by not allowing requisitions and purchase orders from being created for such material.

### **Purchasing Requirements**

M/A-COM learned early on that there was significant confusion industry wide as to what was acceptable and what was not acceptable for RoHS. To ensure that M/A-COM's RoHS requirements were clear, standard documents were created to cover all aspects of purchased products. One such document was 230-702, which clearly delineated restricted and reportable substances. Another important document was 112-65, entitled, "Plating, Tin (Lead-Free), Electrodeposited", which clearly spelled out what was needed for a proper matte tin or bright tin plating bath.

Use of these various documents across the supply base allowed M/A-COM to educate its current suppliers, as well as to have standard specifications that could be sent out to new suppliers.

### **Supplier Surveys**

M/A-COM's ability to comply with the RoHS Directive was closely tied into our suppliers' ability to deliver compliant parts. To understand the scope of how purchased parts would be affected, M/A-COM sent a generic electronic survey to all active suppliers regarding RoHS compliance. Based on those surveys, another more detailed survey, known as Phase 1.5, was initiated in March 2005. This survey asked fourteen questions to determine part and processing compliance. Three key questions in the survey asked if the part was RoHS compliant or not, what was the moisture sensitivity level and the highest processing temperature the part could withstand.

### **Self-Auditing Survey Sheet**

To assist suppliers on their own or as an aide to M/A-COM's quality representatives who are visiting suppliers, a self-auditing survey form was created. This survey sheet in many ways mirrored the efforts on-going at M/A-COM and gauged how ready a supplier was to support RoHS in general and M/A-COM in particular. Typical questions asked in the survey include:

- Does the supplier have a RoHS Roadmap?
- What is the supplier’s part number methodology for RoHS?
- Will there be a cost impact because of RoHS?
- How is the supplier monitoring/controlling their suppliers with regards to RoHS?
- How is RoHS and non-RoHS material segregated on the manufacturing floor?
- Does the supplier have the capability internally to check material compliance?

## Customer Support

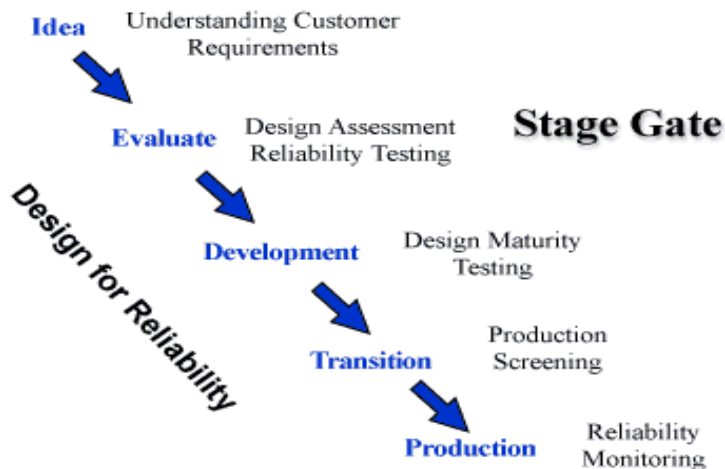
Customer support for RoHS compliant products includes the following items: sales order support, product qualification, material declaration forms, RoHS certificates of compliance, packaging and labeling instructions, warranty letters and an external website. At the same time, M/A-COM’s customer support needed to address non-compliant products, since not all customers specify RoHS compliant products, and in some cases, specifically require lead-based solder (e.g., military applications).

### Sales Order Support

Customer service is guided through the sales order creation process via a series of message alerts that indicate pre-defined customer preferences for either RoHS compliant or non-compliant product as well as providing options for selecting either the compliant or non-compliant equivalent product based on a bi-directional cross-reference. The intent of this functionality is to alert customer service of a possible mismatch between the customer preference and the actual part number being ordered.

### Product Qualification

M/A-COM’s approach to product qualification is provided on the M/A-COM web site (<http://www.macom.com/QualityReliability/index.htm>). M/A-COM also has published a book with CRC Press on reliability entitled “*Design for Reliability*” which covers our approach in detail. M/A-COM uses a Stage Gate approach to design in reliability. The stage gate concept is illustrated below.



Most of a product’s reliability growth is achieved in the idea and evaluation phase. In the idea phase, tools such as Failure Modes Effects Analysis (FMEA) and Design of Experiment (DOE) are used. In the evaluation phase, some of the key qualification tests that are industry standard are:

- Highly Accelerated Life Testing (HALT);
- Thermal Shock, High/Low Temperature Test (operational);
- High Temperature Operating life;
- Humidity Bias Stress Testing; and
- Vibration (operating and non-operating).

Similar tests are also performed in the Design Maturity test phase. However, here reliability growth is not as easily achieved, but reliability verification is targeted. Zero failure testing is typically performed to provide statistically significant product failure rate assessment. Finally in the Transition and Production phase, screening and monitoring are employed to assure the product's quality in the infant mortality portion of the product's life.

### Material Declaration Forms

Today, all Material Declaration Forms (MDFs) are manually generated which is extremely time consuming. M/A-COM's parent company, Tyco Electronics, contracted with Material Compliance Connect (MCC) to automate the MDF process. A pilot program with 25 suppliers was initiated to submit their material declarations with the intent to comply with the industry accepted IPC 1752 Materials Declarations sheet. This pilot program was just recently completed. Plans are being developed, based on the results of the pilot program, for the next phase. Below are examples of sample reports that may be generated using the MCC software.

#### Compliance Report

General Properties			
Part Number:	406337-2	Part Type:	Component
Part Name:	PCB ASSY		
Part Weight (Reference):	0 kg	Revision Level:	K
Part Weight (Calculated):	0.1708 kg	Revision Date:	
Absolute Weight Deviation:	100 %	Part Status:	Imported from BoM

#### Compliance Report

Part Number	Revision Level	Part Name	Level	RoHS Compliance	JIG Level A Compliance	JIG Level B Compliance	Compliance Indicator
406337-2	K	PCB ASSY	1	No	No	No	
569748-1	C	MJ ASSY, 6P, 8 POSN, TOP ENTRY	2	Contains Unreported Parts	Unre		
569667-5	L	MOD JK,HSG,T/E,8POS,6 PORT	3	Contains Unreported Parts	Unre		
26682-1	Z	VALOX 420-SEO BLACK BK1066/7001, A	4	Unreported	U		
5-558392-2	N	TERM,INSERT,CROSSOVER,T/E,CAT5	3	Yes			
5-558392-1	N	TERM,INSERT,CROSSOVER,T/E,CAT5	4	Yes			
26682-7	M	VALOX 420-SEO,GRAY 8051	5	Yes			
1116330-1	D	PCB,6PORT,MULTI-PORT/110,CAT5	2	No			
112-24-3	C	Plating, Tin-Lead Alloy, 60-40%, Electrodeposited	3	No			

#### General Properties

General Properties			
Part Number:	406337-2	Part Type:	Component
Part Name:	PCB ASSY		
Part Weight (Reference):	0 g	Revision Level:	K
Part Weight (Calculated):	170.8 g	Revision Date:	
Absolute Weight Deviation:	100 %	Part Status:	Imported from BoM
Version:		Part Application:	
Division/Product Type:		Part Stage:	
Part Family:		Colored:	
Engineering Specs:		Article:	
		CFCs:	
Recycling Code Standards:		Dismantling Category:	
		RSRC Disassembly Category:	
		RSRC Recycling Category:	
Post-Industrial Recyclate %: (Pre-Consumer)	0	Contained Recyclate %: (as released)	0
Post-Consumer Recyclate %:	0	Contained Recyclate %: (as measured)	0
ISO 1043 and ISO 11469 Polymeric Marking:			
IMDS Recycled Content Comment:			
Contact:			
MSDS File Attachment:			
ATR File Attachment:			
Import File:	bom2.txt (Specification File) 2006-04-24 15:39:52		
Time Stamp:	Mon, 2006 May 08		

#### Substances

Name	CAS Number	Weight (g)	% of Part Weight
Unspecified Compliant Substance	Unspecified Compliant Substance	143.91	84.25644
not yet specified, not to declare		14.6	8.5480094
Tin	7440-31-5	5.16	3.0210773
Antimonytrioxide	1309-64-4	3.69	2.1604215
Lead	7439-92-1	3.44	2.0140515
<b>Total Specified</b>		<b>170.8</b>	<b>100</b>

## RoHS Certificate of Compliance, Packaging and Labeling Instructions and Warranty Letters

M/A-COM includes a certificate of compliance as part of its packing slip, which also indicates if the part is compliant to RoHS. When the packing slip is generated at final pack, the packaging and labeling instructions specific to each customer location are printed out. These instructions are for the benefit of the M/A-COM shipping personnel and are not shipped with the product. They are important since M/A-COM has customers who need to have either different packaging or labeling from location to location. Finally, most customers require, prior to shipments, some sort of assurance that the part is RoHS compliant. This is accomplished by issuing a RoHS warranty letter. See the various examples below.

### Sample Packing Slips with Certificate of Compliance

BILL OF LADING #			300-428-848-5		
NUMBER OF BOXES		TOTAL WEIGHT		28x20x21	
1		54			

**HEADER SHIPPING INSTRUCTIONS:** (NOTE, ITEM INSTRUCTIONS OVERRIDE HEADER INSTRUCTIONS)  
Please add Nokia PO number to all AWB paperwork  
Thank you  
**HEADER MISC. TEXT**

ITEM	M/A-COM MATERIAL #	STORAGE LOC/BIN	EA/PCS	SERIAL# 'S	QTY-ORD	QTY SHIP	QTY B/O
CUST MATERIAL #	CUST REV	Description	(Y/N)				
10	M/AIA-000049-0002SA	FG01	NO	No	8 EA	5 EA	0 EA
Iso-Combiner, 3-2 way combiner, 1800/ 19 EVL/RoHS Code = E- Directive 2000/53/EC ELV compliant Harmonized Tariff: 8504408500 ECCN: EAR99							

For the attention of Timo Kippo  
For the attention of Timo Kippo

The shipper hereby certifies that this shipment contains no untreated solid wood packing material. Treated solid wood packing materials are certified, and stamped, & treated.

The most current version of M/A-COM Standard Terms and Conditions of Sale (available at [www.macom.com](http://www.macom.com)) are incorporated herein by reference and apply unless a superseding overriding agreement exists between the two companies.

M/A-COM Division  
Featherstone Road  
Wolverton Mill  
Milton Keynes, MK12 5EW  
United Kingdom  
VAT REG: GB681471425

Lowell, MA Shipments  
1011 Pawtucket Blvd  
P.O. BOX: 3295  
Lowell, MA 01854-3295 USA  
PHONE: 978 - 442 - 6000  
FAX: 978 - 442 - 4800

Page: 2 of 2  
M/A-COM S/O #: 184822  
DATE: 25 Jan 2006  
CREATED DATE: 25.01.2006  
DELIVERY #: 81515763

These commodities, technology or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law prohibited.



"We hereby certify the product(s) in the quantities listed above are furnished in accordance with the mutually agreed upon requirements, specifications, and drawings. Inspection and/or tests have been performed on a variable, attribute and/or SPC basis, utilizing equipment calibrated in accordance with applicable standards. Only new Materials have been used in the fabrication of the product(s). Test data and/or reports are on file."

Kathy daSilva  
Director Business Support

In the event that your order arrives damaged, please note the damage on the carrier's Bill of Lading when signing for the goods, hold all material and packaging for possible inspection and, access M/A-COM's web site for detailed instructions on how to resolve the damage.  
[http://www.macom.com/Customer\\_Service/index.htm](http://www.macom.com/Customer_Service/index.htm)

### Imbedded Certificate of Compliance

## Packaging and Labeling Requirement Information

Sales Order 184822

Delivery Number 81515763

### Packaging and Labeling Requirements

Page 1 of 1

*Ship-To Party: 28602*

Nokia Networks  
Preproduction, Oulu  
Kaapelitie 4, Preproduction  
90630 OULU  
FINLAND

Customer specific Packaging and Labeling Requirements

**Packaging Code** 3C Seg Parts, Shp Sep

**Labeling Code** 4A RoHS Compliant

Delivery Details			
Line No.	Material Description	Qty	ELV/RoHS Code

## Sample Warranty Letter

	<p><i>Tyco Electronics Corporation</i> P.O. Box 3608 Harrisburg, PA 17105</p>
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May 7, 2004

To Whom It May Concern:

The following part numbers are RoHS compliant, meaning they have a maximum concentration of 0.1% by weight in homogenous materials for lead, hex chrome, mercury, PBB, PBDE, and 0.01% for cadmium.

1489669-1  
1367073-1  
1367147-3

The above information is provided based on reasonable inquiry of our suppliers and represents our current actual knowledge based on the information provided by our suppliers. This information is subject to change. This information does not in any way modify existing purchase specifications or existing contractual or other agreement terms between Tyco Electronics Corporation (or its affiliated companies) and its customers.

Best Regards,  
Jodi Koppenheffer  
Product Engineer

## External Web Site

An external website ([www.tycoelectronics.com/customer-support/rohssupportcenter](http://www.tycoelectronics.com/customer-support/rohssupportcenter)) was created to support all of our customers. At this site, a customer may enter an existing part number to find the RoHS equivalent part number. It also has a Frequently Asked Question (FAQ) section, technical data section and a host of other important information pertaining to RoHS.

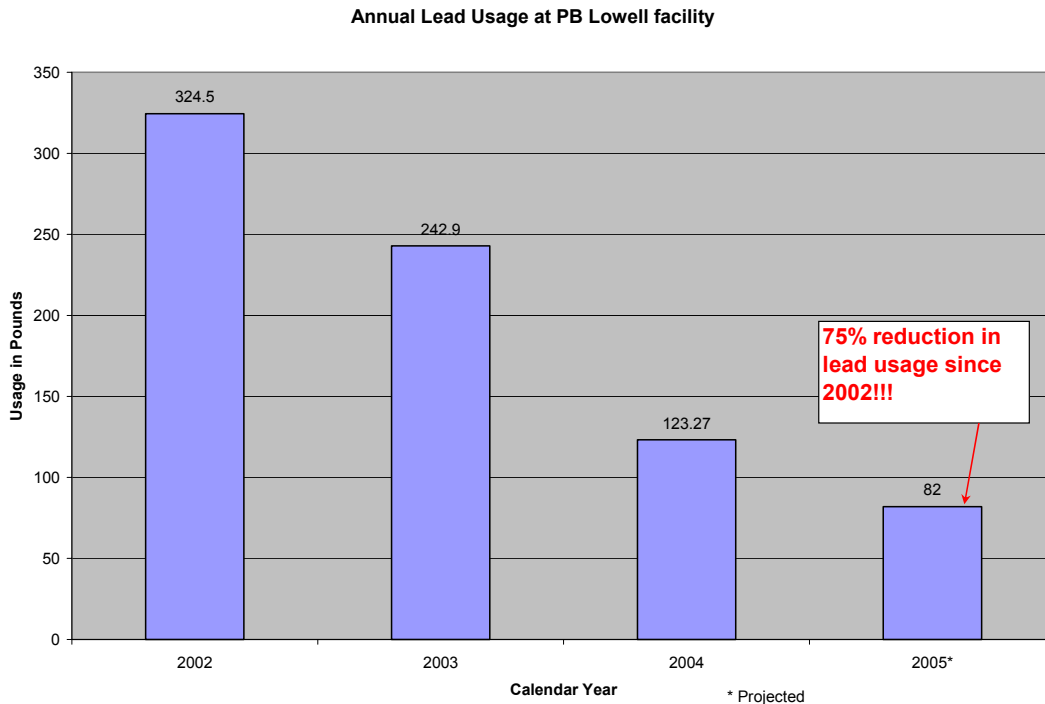
## RoHS Data Infrastructure

M/A-COM uses software from SAP as its ERP software. Due to the scope of the issue, careful planning and control of the master data infrastructure is required to assist in tracking the purchasing, manufacture and sale of RoHS and non-RoHS compliant product.

M/A-COM decided to assign new part numbers for its compliant products and as product families became compliant they would be identified with new part numbers. Bi-directional cross-references exist to relate non-compliant product to its compliant direct equivalent. All piece parts are controlled with the RoHS code previously discussed.

## One More Reason to go Lead-Free

An additional benefit from the RoHS process was the reduction of lead usage. The chart below shows a 75% reduction in lead usage since 2002. By reducing the Pb usage below 100 pounds per year, this facility will avoid EPA and TURA reporting and the associated costs.



## Summary

In summary, for M/A-COM a well-managed RoHS compliance process is only achievable through the efforts of a cross functional team that has the following:

- Strong support from Senior Management;
- Corporate Oversight Team and Local Site Specific Teams;
- Periodic reviews conducted at the local, as well as, the corporate level to ensure that issues are identified and resolved quickly;

- IT support to update the infrastructure system and build in safeguards for customers and suppliers;
- Part and process coding;
- Employee awareness and training, including an internal website, posters and a policy statement;
- Supplier oversight and support; and
- New manufacturing processes.

Because of the outstanding team that was put together, along with strong Senior Management support, M/A-COM is poised to support its customers and its suppliers through the RoHS conversion process and into the future.

## Appendix – Examples of IC Compliance Tests

Test	Typical Problem	Typical Stress	Typical Duration	Sample	Applicable Standards
Preconditioning and Moisture sensitivity	SOIC, Multichip, Hybrids. Common problems are pop corning and package delaminating	a) Soak 85°C, 85%RH	a)168 Hours	30	REL-201, JESD22-A113D
		b) SMT reflows 260°C Peak Temp. Required	b) 3 Times		
Solderability or MUST Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	Solder Pot	Dip	5	REL-201, JESD22-B102-D, J-STD-002B
Tin Whisker (1) Process Acceptance Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	-55°C to 85°C Or -40°C to 85°C	10-Minute Dwells, 500 air-to-air shocks	9	REL-205 JEDEC BALLOT 4/5/05
Tin Whisker (1) Technology Acceptance Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	-55°C to 85°C Or -40°C to 85°C	10-Minute Dwells, air-to-air shocks 1000 Minimum 1500 preferred.	9	REL-205 JEDEC BALLOT 4/5/05
Tin Whisker (2) Process Acceptance Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	60 ±5°C, 87±3% RH	1000 hours min. 1500 hours preferred.	9	REL-205 JEDEC BALLOT 4/5/05
Tin Whisker (2) Technology Acceptance Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	60 ±5°C, 87±3% RH	1000 hours min. 4000 hours preferred.	9	REL-205 JEDEC BALLOT 4/5/05

## Appendix – Examples of IC Compliance Tests

<b>Test</b>	<b>Typical Problem</b>	<b>Typical Stress</b>	<b>Typical Duration</b>	<b>Sample</b>	<b>Applicable Standards</b>
Tin Whisker (2) Process Acceptance Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	Ambient Storage (20 – 25°C, ~30-80% RH)	1000 hours min. 1500 hours preferred.	9	REL-205 JEDEC BALLOT 4/5/05
Tin Whisker (2) Technology** Acceptance Test	SOIC leads, plastic package leads, gold plated leads plating issues on leads such as tin or Pb-free plating. Pb-free solder/joint issues	Ambient Storage (20 – 25°C, ~30-80% RH)	1000 hours min. 4000 hours preferred.	9	REL-205 JEDEC BALLOT 4/5/05
Thermal Shock Performance Life	Pb-free solder/joint issues (examples: BGA/LGA/SMT Problems like fatigue, fracture, and solderability)	-40°C to 125°C	Minimum 500 cycles/shocks	30	REL-201, IPC 9701
Vibration	Pb-free solder/joint issues (examples: BGA/LGA/SMT Problems like fatigue, fracture, and solderability)	11 Grms, 5-2000 Hz	1 Hour	10	REL-202 – Level 2
Drop Shock	Pb-free solder/joint issues (examples: BGA/LGA/SMT Problems like fatigue, fracture, and solderability)	30 inches	3 Edgewise Drops	10	REL-202
X-RAY	Pb-free solder/joint issues (examples: BGA/LGA/SMT Problems like fatigue, fracture, and solderability)	NA	NA	1 to 3	REL-201
RoHS Analysis	Material analysis	Pb, Cd, Hg, Cr6, PBB, PBDE Testing	See Part 2	1 to 3	REL-205 Part 2
Salt Fog	Plating issues	3% NaCl, 35C	48 hours	1 to 3	REL-205 Part 2