

Finisar

RoHS IMPLEMENTATION

CHALLENGES FOR SMALL AND MEDIUM SIZED COMPANIES

Tom Ellison and James Szabo
Finisar Corporation

OUTLINE

- Major Steps involved in Conversion
- Costs of Implementing RoHS
- Technical Issues in Chemical Auditing

THINGS TO DO LIST

- Review & Convert BOMs to RoHS parts
- Change to Lead-Free Soldering Process
- Gather & Compile “Due Diligence” Documentation
- Set-up an Incoming Component Auditing process
- Contemplate Reliability Issues

BOM REVIEW & CONVERSION

- Evaluate Material Composition of Each Part
 - Find RoHS Version of Purchased Parts
 - Redesign Custom Parts (Exemptions)
 - Apply for exemption if there is no substitute
- Decide Part management Strategy
 - New Part numbers
 - Phase in / Phase out
- Change Approved Vendor List(s)

BOM CONVERSION COSTS

- Purchased Parts (Find a RoHS compliant version)
 - 1-1.5 Hrs per PN x \$75/Hr = \$93 / PN
 - 50-100 PNs per BOM = \$7000 / Product
 - 20-30 Products x \$7000 = **\$ 175,000**
- Redesign of Custom Parts
 - 10 Hrs per PN x \$100 / Hr = \$1000 / PN
 - 5 PNs per BOM x \$1000 = \$5,000
 - \$5,000 X 25 Products = **\$125,000**
- Total for BOM Conversion = **\$ 300,000**

NEW SOLDERING PROCESSES

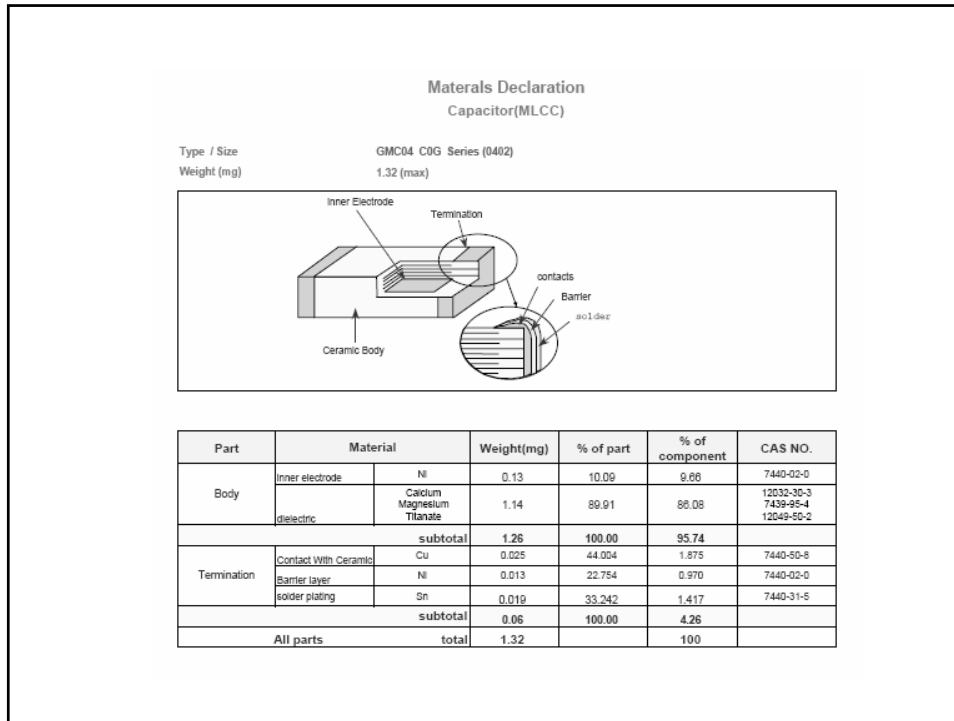
- SAC Alloy? (Sn / Ag 3% / Cu 0.5%)
- Higher Reflow Temperature
 - (245 -270C vs. 210-230C)
- Mixed Technology (Lead & Lead-free Parts)
- Higher Rework / 2nd OP Temperatures
- Poorer Solderability
- New Workmanship Standards

Process Conversion Costs

- Will CM to Absorb Process Development Costs?
- Parts & Assembly Costs for Qualification Runs:
 - Assume Average Unit BOM Cost of \$100:
\$100 x 100 parts = \$10,000
 - \$5000 per Run SMT & 2nd Line Time Costs
 - 20-30 Products: 25 x \$15,000 = \$375,000

“DUE DILIGENCE” DOCUMENTATION

- Collect Certificates Of Compliance
- Collect Materials Declarations
- Evaluate Validity Of Certificates/Declarations
 - Detailed Materials Declarations
 - Detailed Surveys
 - On-site Supplier Audits
 - Chemical Test Data from Third Party Laboratory
- Store in Docs in Data Management System
 - \$150,000 for Document Control Database
 - \$40,000 to \$50,000 for RoHS Add-on Module
- Total for “Due Diligence” = \$200,000



MATERIALS DECLARATION

provided by a European plastics supplier.

“....the following substances are not intentionally used or added:

- The heavy metals cadmium, lead, chromium (VI) and mercury
- Polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)

Since the presence of the above-mentioned substance(s) couldn't be expected under normal conditions, **the absence has not been checked by tests.**

Although the above-mentioned substance(s) is (are) not intentionally added, **this does not exclude the presence of negligible traces due to (among others) impurities in the components supplied by third parties and used in our production facilities....”**

DOES IT CONTAIN: 0.1% Pb, Hg, Cr(VI), PBB, PBDE; 0.01% Cd?

AUDITING & TESTING

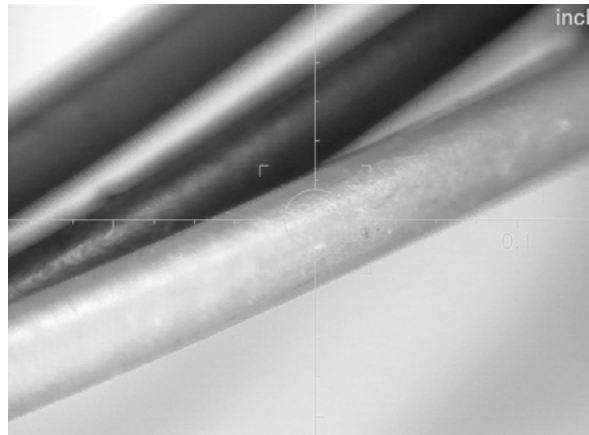
- **RoHS Maximum Concentration Values (MCV):**
 - 0.1% (1000 ppm) for Pb, Cd, Cr, PBB and PBDE
 - 0.01% (100 ppm) for Cd
- MCVs are for each homogeneous layer of the part

Potential Strategies

- **Enforcer Model** – Where would I look if I were Customs?
- **Environmental Model**—Largest Environmental Impact?
- **Bookkeeper Model**—All homogenous layers of every part!
- **Reasonable Person Model**—Balance risk vs. reward
- **Raw Materials Model**—Have suppliers test raw materials

XRF Screening: A Cable Example

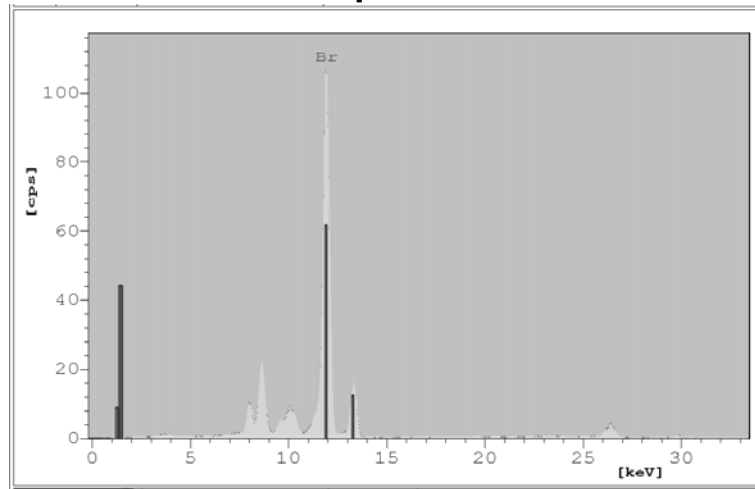
TYPICAL XRF EQUIPMENT COST = \$50,000



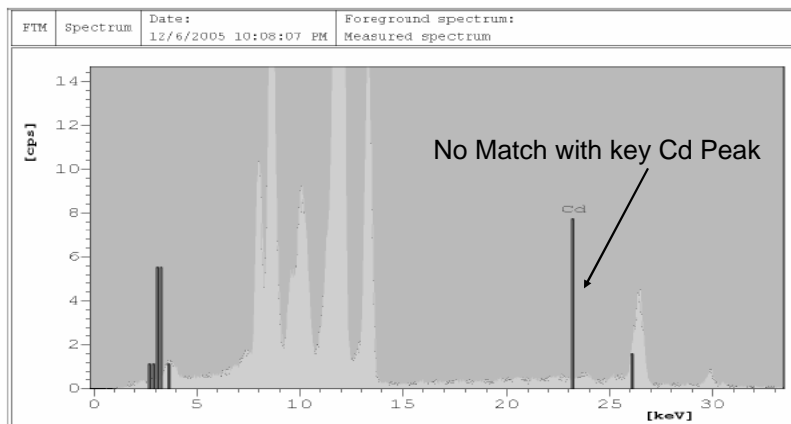
XRF Inspection of Cable Insulation

<u>Item</u>	<u>Pb[ppm]</u>	<u>Hg[ppm]</u>	<u>Cd[ppm]</u>	<u>Cr[ppm]</u>	<u>Br[ppm]</u>
Wire					
Insulation	73.3	3936	973.9	0	70020
<u>Calibration</u>					
XRF Value	45.1	96.0	77.3	96.4	928.4
Std Value	107.8	25.3	114.6	-----	808

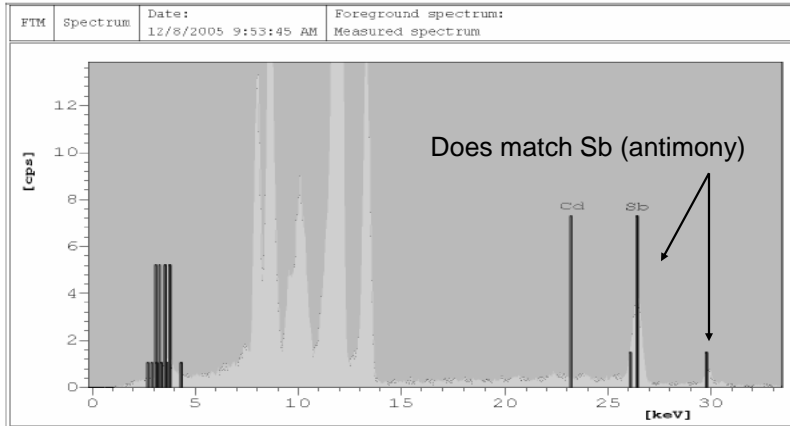
Bromine spectral lines



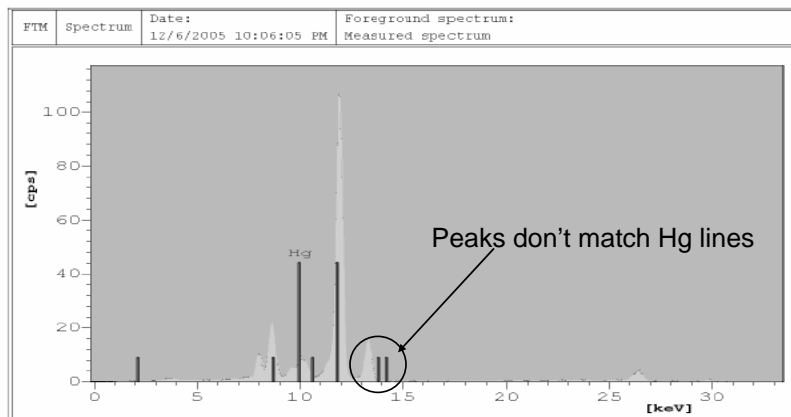
Cadmium spectral lines



Antimony vs. Cadmium



Mercury spectral lines



CHEMICAL ANALYSIS

- Variety of Chemical Analysis Equipment Required
 - ICP-AES (Pb, Cd, Hg)
 - GC-MS (PPB, PBDE)
 - UV-Vis (Cr⁺⁶)
- Typical Costs for Lab Equipment:
 - \$300,000 + Chemist(s) + Laboratory

AUDITING COSTS

Contracting a Third Party Laboratory:

- Assume \$500 / Sample
- Audit 10% of 2000 part inventory
- $200 \times \$500 = \underline{\$100,000}$

Each Homogeneous Layer must Comply!

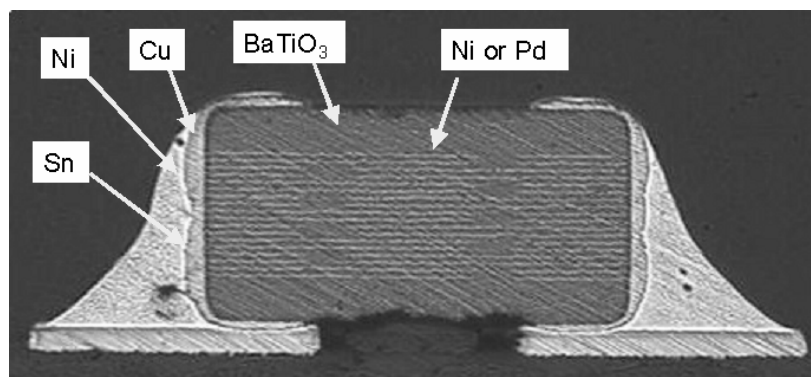
29. The term 'homogeneous' is understood as "of uniform composition throughout", so examples of "homogeneous materials" would be individual types of plastics, ceramics, glass, metals, alloys, paper, board, resins and coatings.

30. The term 'mechanically disjointed' means that the materials can, in principle, be separated by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

From British Dept of Trade and
Industry RoHS Guidance
Document

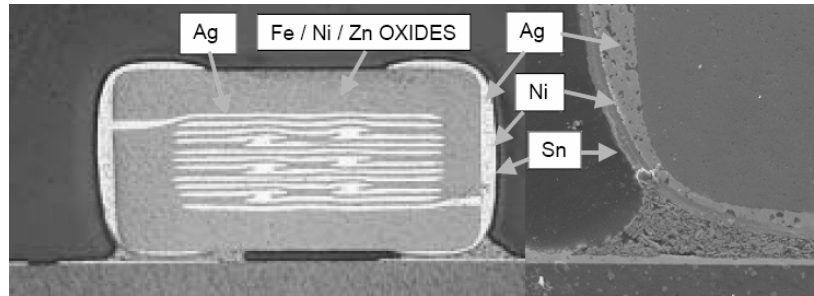
CHIP CAPACITOR

0.5 MM X 0.5MM X 1.0 MM



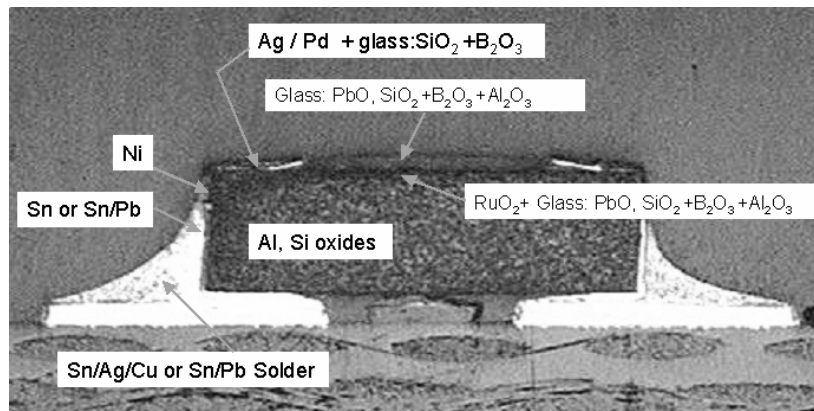
FERRITE INDUCTOR

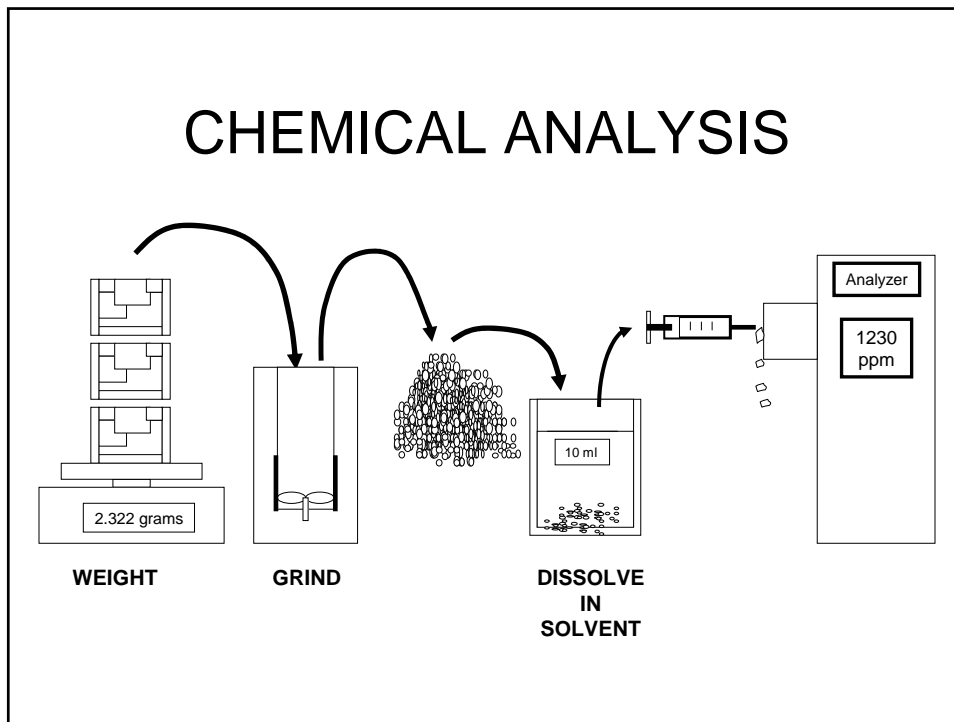
0.5 MM X 1 MM X 0.5 MM



CHIP RESISTOR

0.5 MM X .03 MM X 1.0 MM





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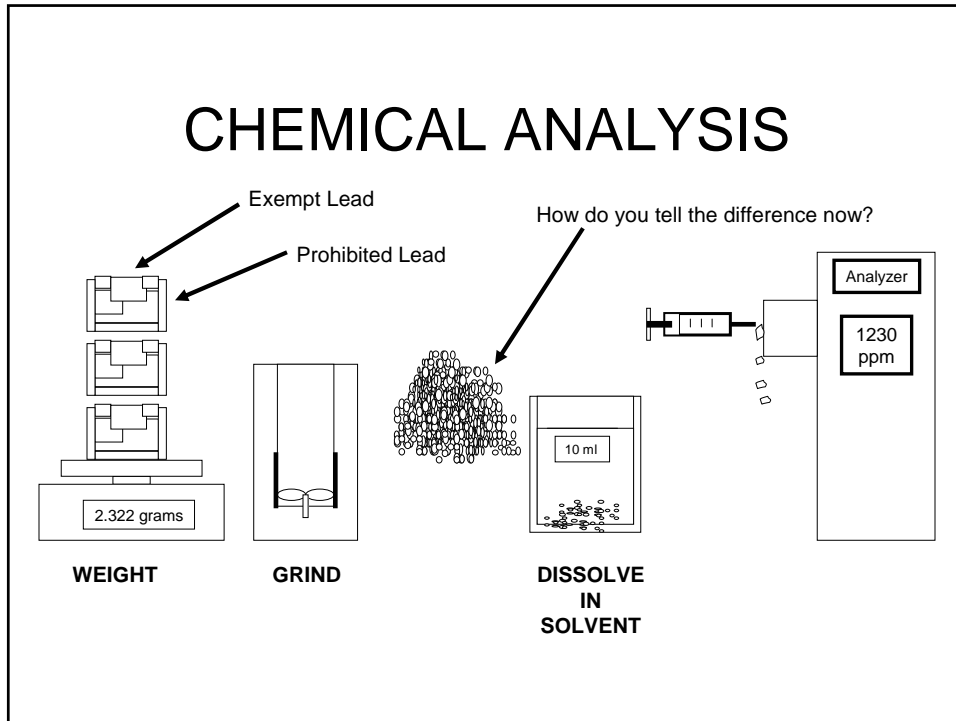
ANNEX

Applications of lead, mercury, cadmium and hexavalent chromium, which are exempted from the requirements of Article 4(1)

1. Mercury in compact fluorescent lamps not exceeding 5 mg per lamp.
2. Mercury in straight fluorescent lamps for general purposes not exceeding:

— halophosphate	10 mg
— triphosphate with normal lifetime	5 mg
— triphosphate with long lifetime	8 mg.
3. Mercury in straight fluorescent lamps for special purposes.
4. Mercury in other lamps not specifically mentioned in this Annex.
5. Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.
6. Lead as an alloying element in steel containing up to 0,35 % lead by weight, aluminium containing up to 0,4 % lead by weight and as a copper alloy containing up to 4 % lead by weight.

**Exemption for Pb
in glass**



LASER ABLATION – ICP-MS

\$550 PER SPOT

Laser Ablation ICP-MS Analysis

Material: Semiconductor Sample
CEA job # C04J5464

Results are relative concentrations in parts per million (ppm)

NBS812 Glass has been used as the reference.

ELEMENTS	A	B	C	D
Mercury	1.0	0.5	0.5	5.4
Thallium	<0.02	<0.02	50.2	1.82
Lead	68.0	18.5	363000	14200
Bismuth	0.36	0.11	77.3	0.56
Thorium	0.28	0.80	0.02	0.41
Uranium	0.21	0.24	0.06	0.34

RELIABILITY CHANGES IN YOUR PRODUCT

- SAC Alloy Solder vs. Tin-Lead Solder
- Tin Whisker Issues with Cu – Sn Interfaces
- Kirkendahl Voiding with Ni-Sn Interfaces
- New Polymer Materials for 260°C Reflow Conditions
- “Halogen-Free” Flame Retardants (Red Phosphorous)

Reliability Testing

- **Product Re-Qualification Testing**
 - 500 Thermal Cycle, Thermal Shock, Burn-in
 - 1000 Hrs at 85°C / 85% RH
 - Typical Costs of \$100,000 - \$180,000 / product
 - Assuming ½ of the 20 products are same family:
 - 10 Products x \$100,000 = \$1,000,000
- **Tin Whisker Testing:**
 - Thermal Cycle for 1000 hrs, 60°C / 87%RH for 3000 hrs, 30°C for 3000 hrs.
 - 8 SEM Inspections of 6 components at 250X
 - Estimated Cost: \$20,000 - \$30,000 x 3-4 cases = \$100,000

COST SUMMARY

(20-30 Product Conversion)

Activity	Cost
Purchased Part Conversion	\$ 175,000
Mechanical Part Conversion	\$ 125,000
Pilot Assembly Runs	\$ 375,000
Data Management Software	\$ 200,000
Screening & Chemical Test Audits	\$ 150,000
Qualification & Tin Whisker Testing	\$1,100,000
Total Cost Estimate	\$2,100,000

SUMMARY

- RoHS Implementation is costly
- Technical Issues with sampling & Analysis
- Reliability Risks

Tom Ellison
408-542-4195
thomas.ellison@finisar.com