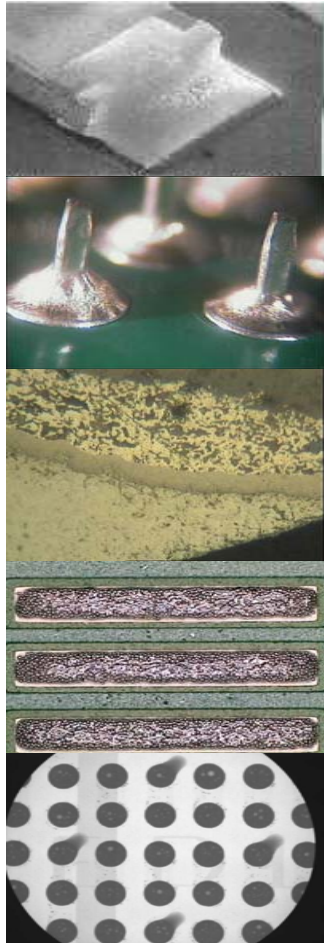


Artesyn's Approach to RoHS (& WEEE) Compliance

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Topics –



RoHS

- Summary
- Implementation strategy
- Lead-free solder process qualification
- Exemptions
- Issues
 - parallel SnPb & leadfree production
 - demonstrating RoHS compliance
 - elimination of Cr6⁺
 - Sn whiskers

WEEE compliance

What is RoHS? Restriction of Hazardous Substances

- RoHS legislation bans six substances from products destined for shipment to EU countries – effective July 1, 2006
 - Cadmium (Cd), <100 ppm
 - Hexavalent Chromium (Cr6+), <1000 ppm
 - Mercury (Hg), <1000 ppm
 - Lead (Pb), <1000 ppm
 - Polybrominated biphenyl (PBB), <1000 ppm
 - Polybrominated diphenyl ether (PBDE), <1000 ppm
- *Concentration limits defined “BY HOMOGENOUS MATERIAL”*
 - *Definition incorporated Aug 2005*

Implementation strategy

- Ensure backward/forward process compatibility
 - Components: Ni-Pd-Au, Matte Sn with Ni barrier
 - Board: high T_g laminate
 - Board finish: OSP, ENIG, ImAg
 - Only fully compliant components stocked
- Reliability testing incorporated into implementation plan
- Global control of solder paste, wave flux choice
- Early (and continuous) factory involvement
 - Process development
 - Process qualification
 - Equipment upgrades
 - Lead-free sample builds

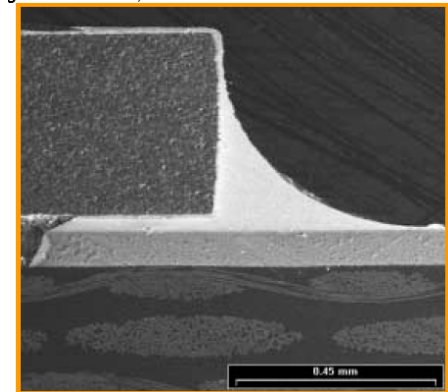
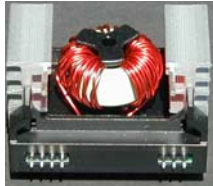
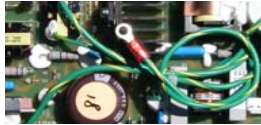
Minimize risk

Lead-free solder reliability testing

- Cornerstone models chosen to represent assembly technologies:

- Samples of SnPb and lead-free tested side by side
- 1000 cycles thermal shock
 - -10°C to 100°C , 30 minute dwell at each extreme
 - Acceleration factors unknown, but survival rates compared for SnPb and lead-free
- HASS screening
 - Thermal cycles, -40°C to 125°C
 - Vibration at 5 GRMS, 10 GRMS, 20 GRMS
- Repeat product functional test
- Failure analysis
- Cross sectioning & metallurgical analysis

- Status: complete, passed



RoHS Exemptions



- Exemptions significant to power supply manufacture (adopted)
 - **Pb** in solder for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunication. Until 2010, review every four years.
 - **Pb** in high melting temperature type solders (i.e. lead based alloys containing 85% by weight or more lead).
 - **Pb** as an alloying element in steel, aluminum and copper.
 - **Pb** used in compliant pin connector systems.
 - **Cd** and its compounds in electrical contacts.

RoHS Exemptions – cont'd

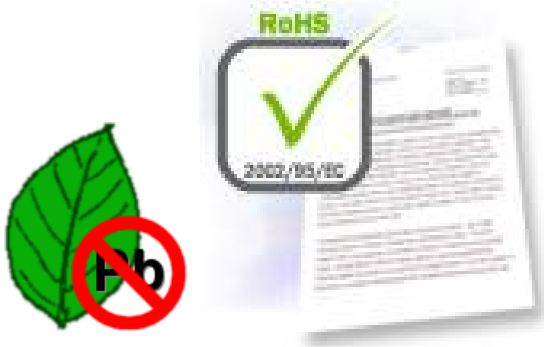


- Exemptions significant to power supply manufacture (proposed)
 - **Pb** in solders in components and assemblies used in non-consumer products, provided that: - such components and assemblies were purchased or are subject to a proven last-time buy contract placed before 1 July, 2006; and - such components and assemblies are used in models of EEE that were already available on the market before 1 July 2006;
 - **Pb** in tin whisker resistant coatings for fine pitch applications
 - **Cr6+** passivation coatings – delay ban until Jul-07
 - For updates, refer to:
 - http://www.dti.gov.uk/sustainability/weee/index.htm#Latest_Information
 - <http://www.tintechnology.com/soldertec/soldertec.aspx>
 - <http://www.rohswell.com>

Parallel SnPb and leadfree production



- The law exempts the use of lead in solder, on high end storage and telecom equipment – *and many customers have decided to take advantage of this exemption*
- Result:
 - Parallel standard products, 6/6 and 5/6 compliant
 - Parallel production SnPb and leadfree
 - Reflow, wave solder and rework
 - Fully RoHS compliant components will be stocked exclusively



TSE-RoHS
5/6 RoHS compliant

Demonstrating compliance



- Ensure suppliers understand “by homogenous material” limits
- Supplier declarations

Component	Description	Vendor	Vendor Material	Component Pb-Free?	Component Hq-Free?	Component Cr6+-Free?	Component Cd-Free?	Component PBB-Free?	Component PBDE-Free?	When Pb, Hg, Cr6+, Cd, PBB, PBDE-free mass production?
I070001	SIGDIO_SW_2_22	ON SEMICONDUCTOR	BAV70LT1G	YES	YES	YES	YES	YES	YES	3/31/2004
I070001	SIGDIO_SW_2_22	PHILIPS SEMICONDUCT	9331 849 10235 - BAV70	YES	YES	YES	YES	YES	YES	1/1/2004
I070002	SIGDIO_SW_2_22	ON SEMICONDUCTOR	BAV99LT1G	YES	YES	YES	YES	YES	YES	3/31/2004
I070002	SIGDIO_SW_2_22	PHILIPS SEMICONDUCT	9332 153 70235 - BAV99	YES	YES	YES	YES	YES	YES	1/1/2004
I070003	SIGDIO_SW_1_25	FAIRCHILD SEMICONDU	BAS16_NL	YES	YES	YES	YES	YES	YES	3/25/2005
I070003	SIGDIO_SW_1_25	INFINEON TECHNOLOGI	BAS16	YES	YES	YES	YES	YES	YES	2/1/2005
I070003	SIGDIO_SW_1_25	ON SEMICONDUCTOR	BAS16LT1G	YES	YES	YES	YES	YES	YES	3/31/2004
I070003	SIGDIO_SW_1_25	PHILIPS SEMICONDUCT	BAS16TRL	YES	YES	YES	YES	YES	YES	1/1/2004

- Supplier Certificates of Compliance
- Supplier audit
- Independent testing – XRF, ICP-AES, ICP-SFMS, GC-MS

Replacing Cr6+ - power supply enclosures

- Test and certify RoHS compliant alternatives to ensure:
 - Surface resistance sufficiently low (EMI)
 - Corrosion resistance sufficiently high (ASTM B117)
- RoHS compliant alternatives
 - Postplated steel: Cr6+ replaced by organic AFP coating
 - Postplating processes: Cr6+ replaced by trivalent chromate
- Proposed exemption to delay Cr6+ ban until Jul-2007
- Specification to restrict fabrication vendors usage to approved materials and processes

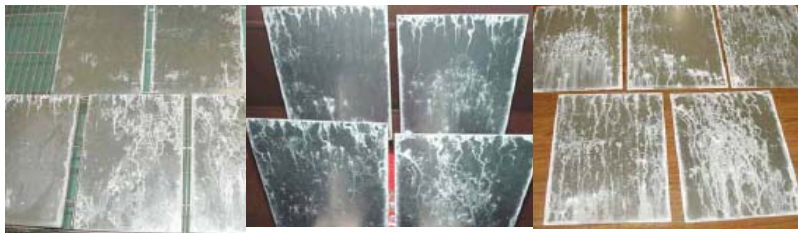


Table 2. Resistance values for "KOBE ROHS COMPLIANT SECC-GX-K2" resistance (ohms)

test location	Side A	Side B
1	0.00012	0.00012
2	0.00012	0.00012
3	0.00011	0.00012
4	0.00012	0.00012
5	0.00012	0.00013
6	0.00014	0.00011
7	0.00011	0.00011
8	0.00011	0.00010

Sn whiskers – mitigation for assemblers

- Review plating options from device manufacturers and choose:
 - NiPdAu
 - Matte Sn over Ni barrier
 - Matte Sn over Cu only if annealed

PART_NUMBER	at or below 1.27mm pitch?	PART_DESCRIPTION	MANUFACTURER	Whisker data	Type of finish (Matte, Bright, gold flash, others {specify})	For Matte Tin list annealing process	Type of metal the finish plating is over, i.e. Cu or Ni	Thickness of the Ni barrier
1380107	yes (1.27)	FET-PWR,NMOS,.30V,12.5A,SMT	FAIRCHILD SEMICONDUCTOR	ON FILE	Matte Sn	1 hour, 150C	Copper,Iron,Zinc	N/A
1380204-0000	yes (1.27)	XSTR,NMOS,.20V,.18A,SMT,VPP9	VISHAY/SILICONIX	REQUESTED	Matte Sn	150C/1hr bake	Cu over Ni	N/A
1380216-0000	yes (1.27)	XSTR,NMOS,.20V,.18A,SMT,VPP9	VISHAY/SILICONIX	REQUESTED	Matte Sn	N/A	Nickel	N/A
1400017	yes (1.27)	IC,OPAMP,S08,MC34072,70CEL	ON SEMICONDUCTOR	ON FILE	Matte Sn	* 150 degree C	Cu	None
1400107-0000	yes (1.27)	IC,CMPAR,S08,LM2903,105CEL	TEXAS INSTRUMENTS	ON FILE	CU NIPDAU	not applicable	CU NIPDAU	Ni = 20-80 micro

- Review whisker test data - JESD 22A121



WEEE – Waste Electrical & Electronic Equipment

- Artesyn products integrated into customer systems
- Not “placed on the market”
- Artesyn “not a producer of EEE” as defined by the law
- Supply content & disassembly information to “producer”
- Position has not been tested

