

RoHS Compliance: THE END of Reliable Electronics?

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May 17, 2005

We replace most electronics not because they break or wear out, but because we want something:

- Smaller
- Faster
- Cheaper
- Lighter
- That runs the latest software
- That has more “bells & whistles”

Restriction on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive — Directive 2002/95/EC:

- Passed by the European Parliament in 2002
- Published in the Official Journal of the European Union on February 13, 2003
- Bans lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB's), and polybrominated diphenyl ethers (PBDE's) in electronics sold in Europe after **July 1, 2006**
- Hefty fines or jail terms for non-compliance
- Will cost \$40,000,000,000 to \$80,000,000,000

Lead:

- Affects the nervous system
- Can cause brain damage in infants and small children

Worldwide annual usage of lead is:

- 80% for batteries
- 5% for bullets
- *0.5% for electronic solders and platings*
(approximately 37 to 40% of typical electronic solder is lead.)

Over 45 different alloys have been investigated as lead-free electronic solders and platings:

- Sn(0.3-4.7)Ag(0.5-6)Cu (SAC) preferred for most Applications — Sn3.8Ag0.7Cu melts at 217°C
 - Sn(0.7-3)Cu preferred for wave soldering — Sn0.7Cu melts at 227°C
- versus Sn37Pb melts at 183°C

Taking lead out of electronic solders and platings can lead to:

- Tin whiskers — short circuits
- Tin pest (tin plague, tin leprosy, tin disease) — open circuits
- Low-melting-point alloys (SnPbBi melts at 96°C) — solder joints that melt in normal use
- Electronics that can not be repaired (popcorning)

(NASA Goddard Space Flight Center Whisker Failures, <http://nepp.nasa.gov/whisker/failures/index.htm#satellite>)

(page 3 of Boguslavsky, Irina, "Whiskers: Truth and Mystery," NEMI/IPC Lead-Free Symposium, Montreal, Canada, September 19, 2002, pp. xx-xx.
<http://thor.inemi.org/webdownload/projects/ese/6Irina-Whisker1.pdf>)

(page 5 of Galyon, George T., Plamer, Larry, "Tin Whisker Microstructural Analysis," IBM eSG.

<http://thor.inemi.org/webdownload/newsroom/Galyon.pdf>)

(page 5 of Brusse, Jay, "Tin Whisker Observations on Pure Tin-Plated Ceramic Chip Capacitors." AESF SUR/FIN Proceedings, June 24-28, 2002, pp. 45-61. http://nepp.nasa.gov/whisker/reference/tech_papers/brusse2002-paper-tin-whiskers-observed-on-ceramic-capacitor.pdf)

(page 1 of Kariya, Yoshiharu, Gagg, Colin, and Plumbridge, William, "Tin pest in lead-free solders," Soldering & Surface Mount Technology, vol. 13 no. 1, pp. 39-40, 2000.

<http://www.smartgroup.org/pdf/tinpest.pdf>)

(Tin pest in tensile sample of lead-free solder
[http://www.geocities.jp/jinyyy/Leadfree/Contents/
Tinpest.htm](http://www.geocities.jp/jinyyy/Leadfree/Contents/Tinpest.htm))

My suggestions are:

- Do not buy any *new* electronics between January 2006 and July 2007
- Avoid “RoHS compliant” products if you can
- Get the longest Extended Warranty that you can for a “RoHS compliant” product, from a company that is big and rich enough that it is unlikely to go bankrupt during the warranty period

Resources:

- RoHS Directive (http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_037/l_03720030213en00190023.pdf)
- <http://www.dbicorporation.com/rohs.htm>
- <http://www.dbicorporation.com/rohsbib.htm>