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RoHS COMPLIANT FABRICATION TECHNOLOGY FOR LEAD-FREE ROTARY ENCODERS

The European Commission (EC) issued the Restriction of Hazardous Substances (RoHS) Directive in early 2003 with the goal of reducing toxic materials within municipal waste. A large part of the legislation focuses on eliminating the use of lead, in particular, the use of lead-bearing solder, in electrical and electronic equipment.

If eliminating lead on printed circuit boards (PCBs) was easy to do and raised no reliability concerns, there would be no reason for concern. As responsible members of the community, we would all convert to lead free assembly right away. But there are such concerns, and the conversion itself is not completely straightforward.

RoHS Directive

Article 4 of the RoHS Directive requires that as of July 1, 2006, new electrical and electronic equipment put on the market must not exceed maximum concentration values for any homogenous material within equipment for the following materials:

- Lead < .1% by weight
- Mercury < .1% by weight
- Hexavalent chromium < .1% by weight
- Polybrominated biphenyls (PBB) < .1% by weight
- Polybrominated diphenyl ethers (PBDE) < .1% by weight
- Cadmium < .01% by weight

Other national regulations have restricted the use of PBB and PBDE for several years. As a result, these requirements are not new to most manufacturers. Hexavalent chromium and cadmium are seldom used in electronics. But the requirement to remove lead from solder, specifically solder on PCBs, causes significant concern for manufacturers.

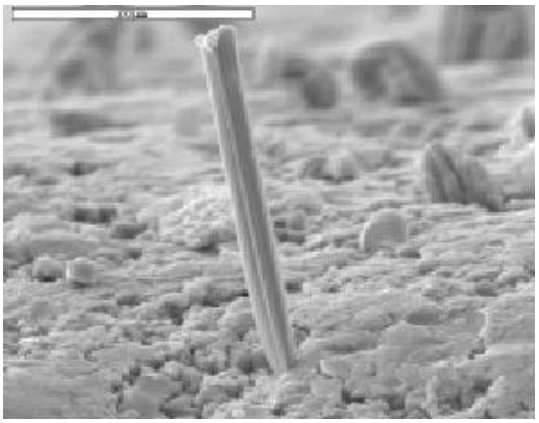
The RoHS standard recognizes that risk to consumer safety must not be compromised. It shows that the EC understands that the critical nature of some systems requires that no chances to be taken. After all, it is one thing to have a television set fail and quite another to have a data server or a life-support system malfunction. Medical devices, automotive applications, aerospace, military, large-scale stationary tools, monitoring and control instruments, computer servers, as well as some telecommunications equipment are currently exempt from compliance.

TRANSITION TO LEAD-FREE ASSEMBLIES

- Effect of Lead Free Soldering Processes:
  All lead-free solders are different from traditional tin-lead solder as they have higher melting points and inferior wetting properties. Wetting will take a little longer and the solder tends to spread less. Most lead-free solders appear dull or matte in comparison with tin-lead, which is usually bright. The visual appearance of a lead-free solder joint is not as good as with tin-lead.

Reflow soldering of lead-free PCBs requires tighter process controls. Component manufacturers recognize possible increase of mortality rates resulting from solder reflow temperatures increasing to approximately 250degC (approximately 40-50degC above tin-lead reflow temperatures). Preliminary research suggests that the Sn/Ag/Cu solder alternative (lead-free) offer superior long-term reliability and joint strength for most applications. However, tests have shown the joint may be a bit more brittle than a lead-tin joint because of thicker intermetallic layers due to the higher soldering temperature.

- Tin Whiskers:



A large area of concern with the use of tin-plated or pure tin component finishes is the occurrence of tin whiskers. This condition arises when tin begins to grow tiny filaments known as whiskers. A tin whisker is a spontaneous columnar or cylindrical filament, of mono-crystalline tin emanating from the surface of a plating finish. Tin whiskers generally have an aspect ratio (length/width) greater than 2; whiskers have been found to be over several mm in length in rare instances. The whiskers can be kinked, bent, or twisted and may be surrounded by striations/rings. These whiskers are very brittle therefore can lead to intermittent or permanent electrical shorts when broken and re-deposited upon the circuit's surface. The origin of tin whiskering is still not completely understood, other than the addition of lead to the solder alloy eliminates this phenomenon completely. Component manufacturers are diligent to mitigate the known causes of tin whiskers by controlling tin plating thickness, finish and regular analysis of plating baths.

SUMMARY

The Institute of Interconnecting and Packaging Electronic Circuits (IPC) states that the total use of Lead in Solder is less than .5% of total US lead consumption. Lead is widely used due to its relatively low melting temperature and because it is uniquely capable of meeting the stringent performance standards required by current technology. The use of lead-tin soldering has been the industrial standard for decades.

Quantum Devices (QDI) is committed to the advancement of lead-free soldering technologies by supplying the latest assembly and material technologies required for European RoHS compliance. Our desire is to support our customers understanding of the technology impact resulting from lead-free soldering processes. Material controls to identify lead free components are in effect. Obtainment of raw printed circuit boards, electronic components and lead free assembly processes are in place for the manufacture of RoHS compliant rotary encoders. Please contact customer service for your RoHS quotation and Certificate of Compliance needs.