

# *Lead-Free and RoHS Implementation*

*Nico C. van Zijl*

# FCI directions

- ▶ **Plating of choice = Matte Pure Tin on Nickel layer**
- ▶ **Required qualifications and status**

|   |  |
|---|--|
| <b>Plating baths</b>  | <b>2 matte Sn baths qualified</b>  |
| <b>Plating process</b>  | <b>2 matte Sn baths qualified</b>  |
| <b>Plating lines put in production</b>  | <b>Lines qualified in S'pore (4x), Japan, Dongguan, Huntington, La Sarthe &amp; Besancon</b><br><br><b>Many lines have dual capability</b><br><br><b>All remaining lines to be qualified</b> |
| <b>Termination styles of products</b>   | <b>Solderability qualified</b><br><b>Solder joint reliability qualified</b><br><br><b>Other styles in testplan phase</b>   |
| <b>Housings of products that will be exposed to increased process temperature</b> | <b>Green/Yellow/Red list of resins available</b><br><br><b>Qualification product by product</b>  |

# RoHS-requirements

Commission is proposing changes

- ▶ **Hazardous substances to be defined by RoHS-directive:**

|  |                |
|--|----------------|
| <b>Lead</b>                                  | <b>1000ppm</b> |
| <b>Mercury</b>                               | <b>1000ppm</b> |
| <b>Cadmium</b>                               | <b>100ppm</b>  |
| <b>Hexavalent Chromium</b>                   | <b>1000ppm</b> |
| <b>Polybrominated Biphenyls (PBB)</b>        | <b>1000ppm</b> |
| <b>Polybrominated Diphenyl Ethers (PBDE)</b> | <b>1000ppm</b> |

- ▶ **Connector is assumed to be 'Homogenous Material'**
- ▶ **RoHS-directive is considered to be written with the aim to remove hazardous substances. As such it is assumed that also levels under the threshold levels that can be removed shall be removed**

# Plating Specifications

- ▶ **FCI Plating of choice:**
  - ▶ **For SMT, PIP and Press-Fit recommended to use Matte Pure Tin on Nickel underplate (typ 1.27 $\mu$ m)**
    - ▶ **Many simplex or precious metal plating options are already available to provide alternative solutions**
    - ▶ **FCI will continue to use SnPb for customers with RoHS exempt**
  - ▶ **Some special plating options are in evaluation phase:**
    - ▶ **Bright Pure Tin for shields and covers**
    - ▶ **Tin/Bismuth for special market segments**
    - ▶ **Reflowed Pure Tin for critical termination styles and applications**
  - ▶ **For BGA FCI will use industry standard SnAgCu spheres**
    - ▶ **Traditional SnPb solder balls remain available**

# Resin Specifications

- ▶ **Lead-Free solders have an increased melting point. As process temperatures increase all housings need to be re-qualified for use in Lead-Free processing conditions**
  - ▶ **FCI is using a peak-temperature of 245/250°C and 260°C for testing lead-free reflow process conditions and/or 260°C wave solder process conditions**
  - ▶ **Priority 1 = housings that do NOT meet 245/250°C (and are exposed to increased processing heat conditions) + specific customer request**
  - ▶ **Priority 2 = housing that meet 245/250°C but do not meet 260°C**
- ▶ **In case housings do not meet Lead-Free processing conditions the use of alternative resins will be taken in consideration**
- ▶ **Business case analysis required for each individual partnumber if resins change is required**
- ▶ **FCI has defined special profiles to test resins for solder heat resistance**
  - ▶ **Reflow @ 245C and Reflow @ 260C**
  - ▶ **Wave @ 260C with option to use heat shields**
  - ▶ **Hand solder**

# Plating Test Procedures

- ▶ **FCI standard whisker test procedure:**
  - ◆ **Test environment exposure**
    - ◆ **All samples to pass preconditioning test**
      - ◆ *Thermal Cycle, 500x*
    - ◆ **3 set of samples in the following environments**
      - ◆ *Dry heat at a temperature of 50°C +/- 5°C (uncontrolled humidity);*
      - ◆ *Heat and humidity storage at a temperature of 52°C +/- 5°C and 90% +/- 5% Relative Humidity*
      - ◆ *Room temperature storage, 23°C +/- 5°C.*
    - ◆ **Store the samples in these environments for 6 months**
  - ◆ **Acceptance criteria**
    - ◆ *A finish is considered whisker free if after the test the effective whisker length is less than 50µm*
  - ◆ **Release conditions**
    - ◆ *Pre-release after 2 consecutive months of whisker formation stability*
    - ◆ *Full release after completion of all tests and meeting requirements*

# Path forward Qualification Package

- ▶ **Provide Qualification Data Package for PCN, based on generic test results by application (crimp, PF, SMT, PIP, wave, etc), completed with product specific details in case products convert and old version is no longer available**
  - ◆ **Handling, Tracking, Shipping and Use instructions**
  - ◆ **Solderability testing results**
  - ◆ **Solder joint reliability testing results**
  - ◆ **Compliant pin process condition test results**
  - ◆ **Compliant pin reliability testing results**
  - ◆ **Mechanical shock and vibration test results**
  - ◆ **High temperature storage test results**
  - ◆ **Tin whisker growth test results**
  - ◆ **Moisture sensitivity level**
  - ◆ **Plating alloy, terminal metallurgy and thickness**
  - ◆ **Compatibility (forward / backward)**
- ▶ **QDP available via web-based library**
- ▶ **PCN for plating change and for resin change**
- ▶ **No PCN in case old version remains available**

Whatever is applicable

# Logistic Handling

- ▶ **When products are released for lead-free processing AND are RoHS-compliant a new P/N will be assigned**
  - ◆ **Because of resin change cost increase may impact pricing**
  - ◆ **Lead-free products that are NOT exposed to increased processing heat will get new p/n when the termination style is qualified for lead-free processing (i.e. lead-free press-fit product is qualified to be use in combination with a lead-free board)**
- ▶ **BGA SnAgCu-spheres are not backward compatible,**
  - ◆ **New P/N's will be assigned to SnAgCu-version**
  - ◆ **Old SnPb-version remains available**
- ▶ **Packaging (also internal) will have unique LF-label**
  - ◆ **FCI supports industry standardization of LF-labeling**
- ▶ **Mixed packaging not allowed**

# FCI Partnumber Strategy for Lead-Free and RoHS compliant products

| FCI Lead-Free and RoHS P/N strategy  |           |           | RoHS-compliant  | RoHS-compatible |
|--|-----------|-----------|---|-----------------|
|  |           |           | no PN-change  | PN-change       |
| reflow product with resin that meets compatibility requirements                                | reflow    | 95100-101 | n.a.  | 95100-101LF     |
| reflow product with resin that does not meet compatibility requirements                        | reflow    | 95200-101 | 95200-101<br>(in case resin is not yet capable to meet lead-free process environment)           | 95200-101LF     |
| press-fit product  | press-fit | 76300-001 | 76300-001<br>(in case press-fit performance has not yet been verified in lead-free environment) | 76300-001LF     |
| plastic peg that is reflowed (resin meets compatibility requirements)                          | reflow    | 12200-500 | n.a.  | 12200-500LF     |
| plastic peg that is reflowed (resin does not meet compatibility requirements)                  | reflow    | 12300-600 | n.a.  | 12300-600LF     |
| reflow product with gold-flash plating and resin that meets compatibility requirements         | reflow    | 42101-001 | n.a.  | 42101-001LF     |
| reflow product with gold-flash plating and resin that does not meet compatibility requirements | reflow    | 42201-001 | n.a.  | 42102-001LF     |
| New Product Development  | any       | n.a.      | n.a.  | 10256-301LF     |

- ▶ **RoHS-compliant = RoHS banned substances are not present or below threshold values**
- ▶ **RoHS-compatible = RoHS banned substances are not present or below threshold values and the product can be processed and is qualified to be used in a lead-free process or environment**

# Conversion Strategy

- ▶ **Align with customers, match their planning**
  - ◆ *Customer timelines are different*
  - ◆ *Some customers have exempt and will not convert*
- ▶ **Confirm qualification @ conversion**
  - ◆ *Plating finish + RoHS banned substances*
  - ◆ *Termination Style*
  - ◆ *Process Conditions*
- ▶ **Match Lead-Free plating line capacity with demand**
  - ◆ *Flexible solutions to provide maximum freedom*
  - ◆ *Outsourcing tin-lead when capacity shortage occurs*
- ▶ **Assure timely publication of PCN in case old tin-lead part is no longer available**