

## **Lead-free Products**

**2003/2004**

**Information provided is necessarily general in nature. For information about specific lead-free devices, please contact your local Secos GmbH Sales Representatives.**

# Lead-free Products

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## **Secos GmbH Is Committed to a Global Lead-Free Environment**



Secos GmbH is dedicated to preserving our environment for future generations and is working proactively with customers and suppliers to comply with the increasing demands and requirements to provide lead-free products.

### **WHY?**

- The electronics industry has been working to provide lead-free products in response to concerns about the environmental impact of the use of lead (Pb) in solder finishes.
- Secos GmbH has chosen to work proactively with customers and suppliers in launching a lead-free initiative: to offer as many lead-free products as possible in 2003, and to offer lead-free finish options on all possible packages by 2004/2005.

This electronic brochure is designed to help you learn more about Secos GmbH's Lead-Free Implementation and the issues and concerns surrounding the industry's efforts to comply with a growing global demand for lead-free products.



## **Secos GmbH Lead-free Policy**

- Company-Wide Policy is to have as many Lead-free products as possible available now, and to expand our lead-free finish options to all possible packages by 2004/2005.
- Customers must specially request Pb-free products (Sn/Pb are considered the current Standard products.)
- Lead free products are clearly identified so they will not be confused with Sn/Pb products.

### **Current Status**

- Steady increase in the number of lead free products shipped.
- Secos GmbH is concurrently continuing production of Sn/Pb products.



## **Lead Free (Pb-Free) Information at a Glance**

### **1. Secos GmbH's definition of "lead free?"**

Secos GmbH's products defined as "lead free" will contain no purposefully added lead either internally or externally. Only trace elements may remain.

### **2. Secos GmbH's definition of products with a "lead free finish."**

These products will have no external lead, but will still contain internal lead in the form of die / lead bonding solder. Remaining lead percentage by weight will vary by product package and type.

### **3. Secos GmbH is committed to environmental friendliness.**

Eliminating Pb from lead plating is just one step towards a "Green Product." Secos GmbH will be taking additional steps in the future and will announce each with the appropriate mechanism, i.e., New Product Announcement or Engineering Change Notice (ECN). We strive to continuously improve the environmental friendliness of our products and meet the demands of our Customers for such. A Material Content List is available for most products. Please request this report through your Sales Representative.

### **4. Secos GmbH's Road Map for Pb-Free and where products are manufactured.**

Secos GmbH has chosen to offer many of our products in both the traditional and lead free versions. Small outline packages (SOD, SOT, SC-59) are offered both ways. SMA, SMB, and larger packages are offered in leaded and lead free lead finish. Over time, as demand warrants, the traditional leaded products will be discontinued. This will be announced by a Engineering Change Notice (ECN). Demand will affect which packages are discontinued first.

Finished products are built in the Peoples Republic of China and several European countries.

### **5. Lead free options may not be offered for 100% of Secos GmbH's products.**

This depends on demand. Major customers who continue to require SnPb finish may be accommodated for a period determined by individual agreements.



## Lead Free (Pb-Free) Information at a Glance (Continued)

### 6. **Products with the new matte tin finish can be used with Pb containing solders.**

The new matte Sn finish will be backward compatible with Pb containing solders. Conversely, the current product with SnPb lead finish can be used with Pb free solders. A slight Pb contamination of the solder joint from Pb migration out of the lead plating may result but should not harm the joint. Soldering profiles may need to be adjusted slightly depending on the many design and usage variables.

### 7. **There will be no specification changes other than the lead finish.**

Products will continue to be qualified to 260°C solder re-flow profiles. Moisture Sensitivity Level (MSL) will remain 1 unless specifically announced otherwise on an individual product. Reliability and Qualification Testing will remain as is before with the exception of additional Solderability Testing using Pb free solders. No major changes should be necessary in customer's processes except for solder profile adjustments.

### 8. **Details on product availability.**

Small outline packages are available in both versions now (year 2003). Lead free finish on many larger package products is also available now. Some Axial products traditionally been manufactured with pure Sn plated leads and have been available in production quantities for some time. Please contact your sales representative for more information, to request samples or to request a Qualification Package for a specific product.

An ECN will be issued announcing expected discontinuance dates of our remaining lead-containing products by package type. There will most likely be at least a short period of time where both versions of these products are shipped.

### 9. **Prices may change.**

There are many variables that impact pricing. While we anticipate a slight manufacturing cost increase for lead free product versions, we do not anticipate any immediate change of pricing because of this lead finish change.



## Lead Free (Pb-Free) Information at a Glance (Continued)

### 10. Part Numbers will change.

A part number suffix is used to designate lead free or lead free finish versions of product from the traditional lead containing version. The suffix used is a "-LF."

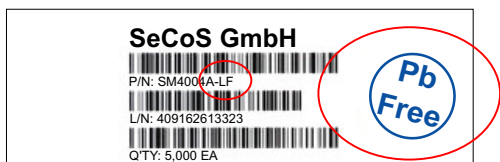
Examples: To order the a lead free version of a Surface Mount Switching Diode in a SOT-323 package (BAV99W), you would order a "BAV99W-LF."

To order a 1 Amp, 400 Volt Standard Recovery Rectifier in an SMA package (SM4004A) with Lead Free Lead Finish, you would order "SM4004A-LF."

Please see our data sheets for specific product ordering information.

### 11. How to read the labels of the product.

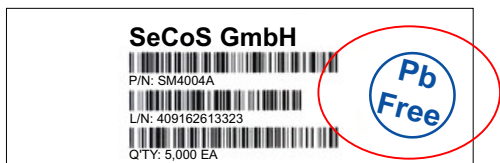
Product labels on reels and packaging will contain the full part number including the "-LF" where the product is Lead Free or Lead Free Finish. A "Pb Free" symbol will be stamped onto the label.



Exception:

Some customers may insist that the part numbers stay the same. On this occasion, "-LF" will be omitted while only the "Pb Free" stamp is used to indicate the lead-free characteristic of the product.

\*\*\*On purchase orders, customers still need to specify "Lead-free" to indicate that they want the lead-free version.\*\*\*





## Lead Free (Pb-Free) Information at a Glance (Continued)

### 13. **Testing done to qualify lead free finishes for use in standard SMT/Through-hole assembly processes.**

Each product family where the lead finish is being converted to Pb free has been or will be re-qualified by subjecting a family sample to the following tests (typical):

Preconditioning (PC) followed by:

Highly Accelerated Stress Testing (HAST)

Autoclave (AC)

Temperature Cycling (TC)

Solderability

With SnCuAg Solder

With SnPb Solder

Resistance to Solder Heat (RSH)

### 14. **Please refer to Data Sheets for change indications.**

Most Data Sheets will contain ordering information for each version of a component where more than one version is available. Also, the Features Section will indicate when a Lead Free Version of a product is available or if a product is Lead Free by design.

The Mechanical Data Section will have a notation when Lead Free Finish versions of products are available.





## Lead Free Product Specification

Secos GmbH is dedicated to preserving our environment for future generations and Secos GmbH offers most small packaged discrete products in a lead free version. These include SC-59, SOP8, SOD-123, SOD-323, SOD-523, SOT-23, SOT-89, 0805, 1206, 2010 SOT-323, SOT-363, SOT-523, and SOT-223.

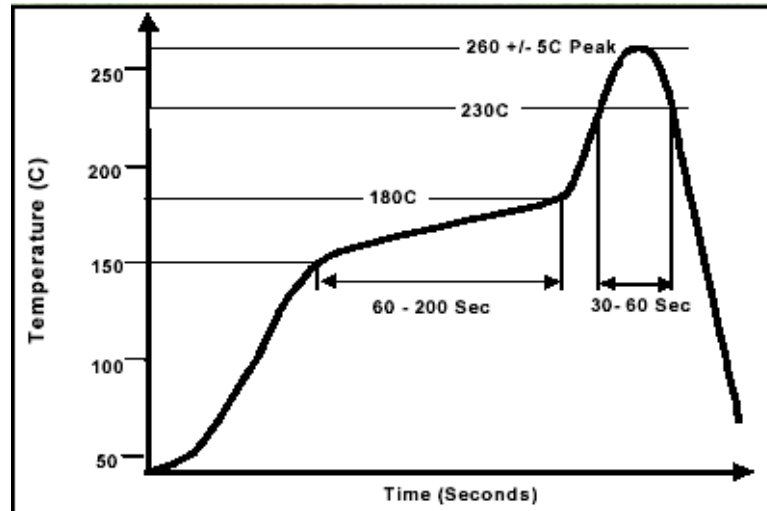
Secos GmbH offers most other products in an external lead free finish version. These include packages SMA, SMB, SMC, TD2P, DPAK, TO-3P, TO-220 DO-41, DO15 and others. Please enquire about specific product availability.

The above products may be ordered in lead free finish versions by adding the suffix “-LF” to the existing product type number. The plating is Matte Tin. Standard SnPb plated products as released also remain available. New products will only be released with lead free plating. Please see the product’s Data Sheet for specific lead finish information.

Lead free finished products are compatible with most lead free soldering alloys including such combinations as SnAg, SnCu and SnAgCu. The lead free finish remains backward compatible with lead containing soldering alloys.

All products will withstand a peak reflow temperature of 260°C for 10 sec. in a 230°C 60 sec. reflow zone with a preheat of 150°C to 180°C for 60 to 200 seconds. Flow soldering heat resistance is specified at 265°C for 10 sec.

## Standard Soldering Profile



Members of each product/package family have been tested in the Lead Free Finish versions.  
Test conditions results are as follows.

Test Item	Industry Standard	Conditions	Result
1 Plating Surface Finish	Visual	N/A	Passed
2 MSL Certification	Modified J-STD-020B	260°C Reflow Profile	Passed
3 Autoclave	JESD22-A 102	121°C, 100% RH, 96 hr	Passed
4 Temperature Recycling	JESD22-A 104	-55°C to 150°C, 1000 cyc	Passed
5 Biased Humidity	JESD22-A 101	85°C, 85% RH, 1000 hr	Passed
	JESD22-A 110	130°C, 85% RH, 96 hr	Passed
6 Solderability	JESD22-A 102	245°C, 5 sec SnPb & Sn solder	Passed
7 Medium Temp Storage Bake	N/A	50°C, 1344 hr (whisker test)	Passed
8 Plating Polymer Material Test	National Testing Center	N/A	Passed

Note: Whisker growth is controlled by precise process and material control.  
Material grain size is controlled to 7 ~ 8 μ m with no organic foreign material.  
Plating thickness is 5 ~ 13 μ m. Plating current density is controlled to < 40A.

## Experiments (1)

### 1) Purpose

To evaluate lead free whisker growth

### 2) Machine

Kaihong Plating Line #1

### 3) Process Flow (Applicable for Copper or Alloy 42 lead frame)

Ø De-scale	JQ-7	40~60 -
Ø Rinse		
Ø De-rust	H <sub>2</sub> SO <sub>4</sub> (8%)	30~40 -
Ø DI rinse		
Ø Activation	Sulfonic Acid	
Ø Plating	Tin concentrate	1~2ASD
	Sulfonic Acid	
	Additive (XinYang)	
Ø Neutralizer	Alkalescent	60~80 -
Ø DI cold rinse		
Ø DI hot rinse		60~70 -
Ø Air blow		
Ø Dryer		65~90 -

### 4) Process Control (Applicable for Copper or Alloy 42 lead frame)

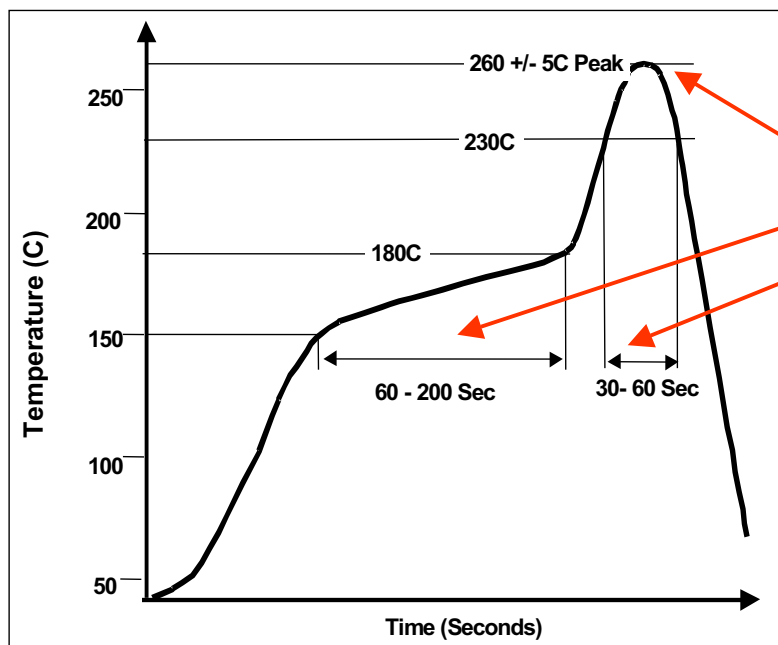
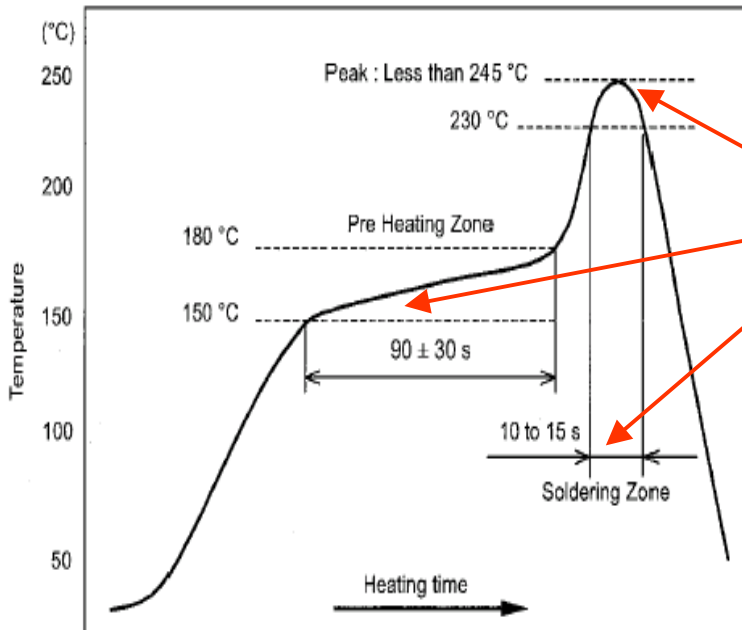
#### Ø Material Control

Control material grain size 7~8  $\mu$  m  
Control Organic foreign material

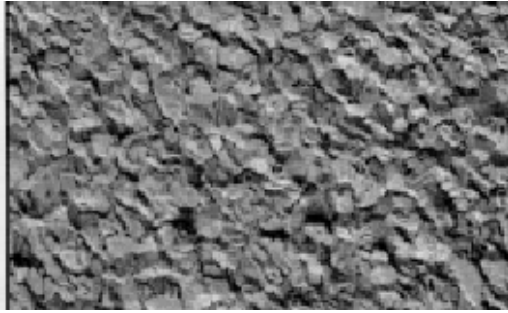
#### Ø Process control

Control plating thickness: 5~13  $\mu$  m  
Control plating current density: <40 A

## Standard vs. Lead Free Solder Reflow Profile



## Results of Whisker Growth Test



Test Start, Week 0 (1000X)

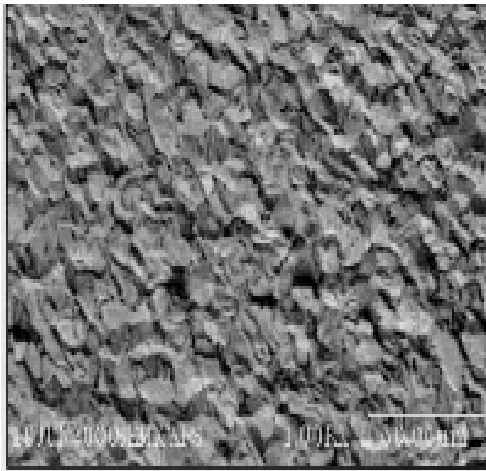


Week 8 (2500X)

After 1344 hours, samples were stored at 85°C, 85%RH for 52 weeks.  
At 52 weeks, samples were inspected under 10,000X magnification.  
Maximum whisker growth on samples was observed to be 10  $\mu$  m.

## Whisker Growth Result (1)

### Lead Free Sample Whisker Growth Simulation / Characterization



Chemical Supplier A's Sample-1000X

- No whisker after 6 weeks of storage at 55 °C oven bake



Chemical Supplier B's Sample-3000X

# Whisker Growth Result (2)

Storage Condition: 85- and 85%RH



0 week X2500



8 weeks later X2500



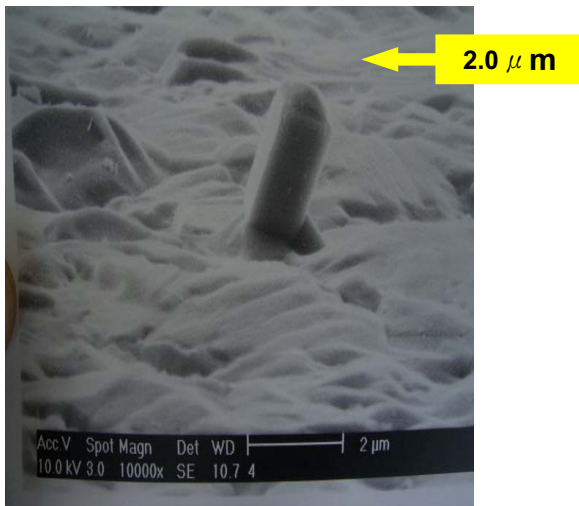
16 weeks X5000



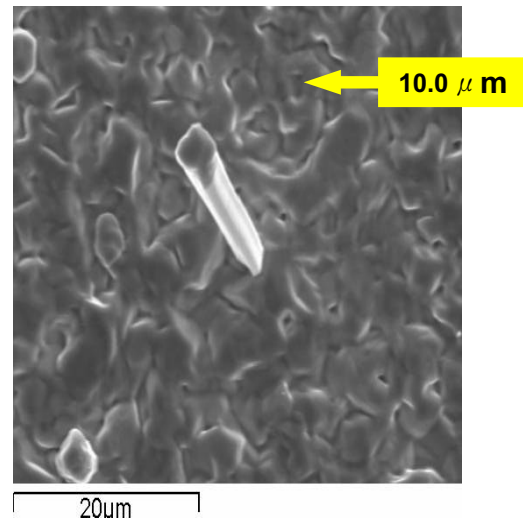
24 weeks X16600

## Whisker Growth Result (3)

Storage Condition: 85- and 85%RH



32 weeks X10000



52 weeks X10000

Conclusion: \* 10 μm whisker growth after 52 weeks storage;

Growth rate=0.2 μm/wk

\* Equal to or Better than Industry Standard