

The Newest Surface Finish Alternative

LEAD-FREE HASL

It's Development and Advantages

Cemco lead-free project work

1999

- Embarked on a test program using Cu/Sn with vertical and horizontal HASL machines.
- Experimented with new parameters, including higher operating temperatures.
- Inert gas was introduced but offered no advantage
- Samples boards provided by Nortel were produced, assembled and tested with good success.

Cemco lead-free project work

2000

- Cemco Services set up the first lead free HASL service providing customers with Sn99.3./Cu0.7 board samples using a vertical Quicksilver system.



Cemco lead-free project work

2000 - 2005

- Product testing in participation with major material suppliers.
- Testing using a new generation of a patented trace element alloy.
- Engage in test programs in collaboration with leading technical workgroups.
- Continued development of process and equipment.

Key differences in Process Requirements between lead-free and Sn/Pb HASL

- Higher run temperatures for lead free solder

Alloy	Melting point	Process temperature
Sn/Pb	183° C	250° C
HASL Lead-free	217 to 227° C	265 to 280° C

- Longer contact time
- Effective heat transfer by improved alloy circulation and pre-heating the panel (pre-dip).
- High temperature resistant chemistries (oils and fluxes)
- Copper control

Copper Control

- **Dilution**

- **Skimming**

Copper skimming trials



**Photo's showing copper dendrite formation
during R&D copper skimming trials**

Key differences in Equipment between lead-free and Sn/Pb HASL



Lead-free Vertical Machine

- Increased power requirements
- Precise control during the heat-up cycle
- More efficient circulation of solder within the sump
- Lead free specific Air-knife profile

Quality of lead-free HASL v Sn/Pb HASL

- Superior control of coating thickness on surface features
(typical working range of 1.75 to 15 μm across the board)
- Superior control of hole size
(typical 0.025mm less than pre-level copper size)

Note: (Sn/Pb can range from 1 to 25 μm across all features and 0.05mm hole reduction)

How good is Lead-Free HASL ??

Recent trials using common iNEMI test panels
(Collective readings across range of features including large ground areas)

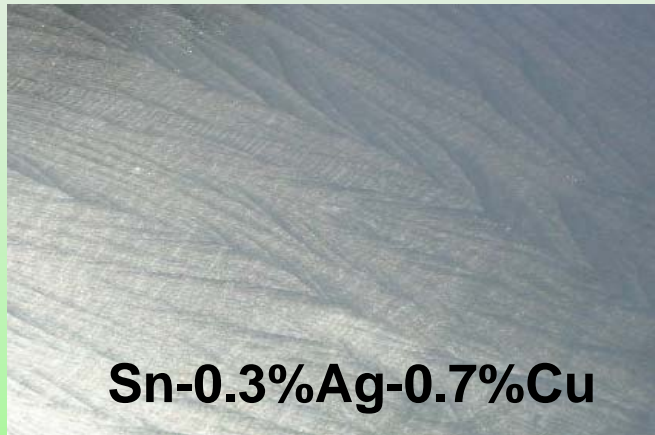
Sn-0.3%Ag-0.7%Cu 2.61 - 14.2 μm

Sn-3%Ag-0.5%Cu 1.0 - 12.3 μm

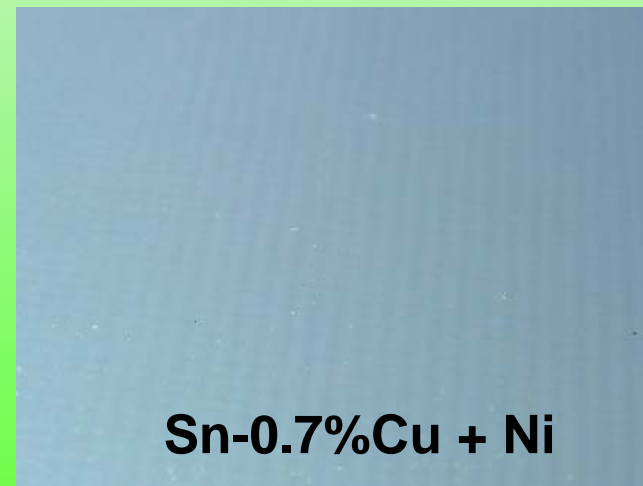
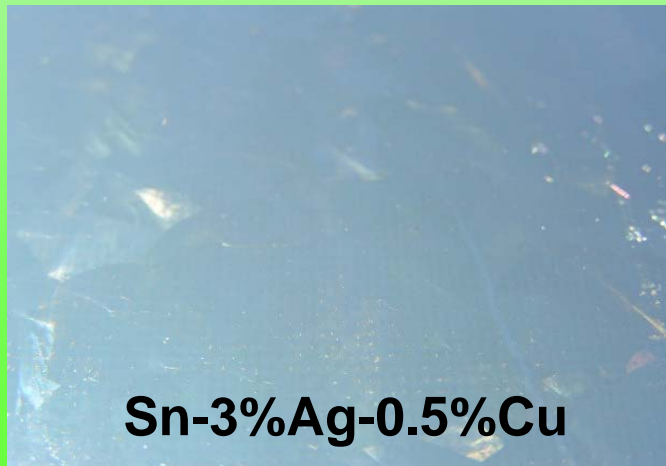
Sn-0.7Cu + Ni 2.7 - 14.7 μm

Equipment... Quicksilver vertical leveler

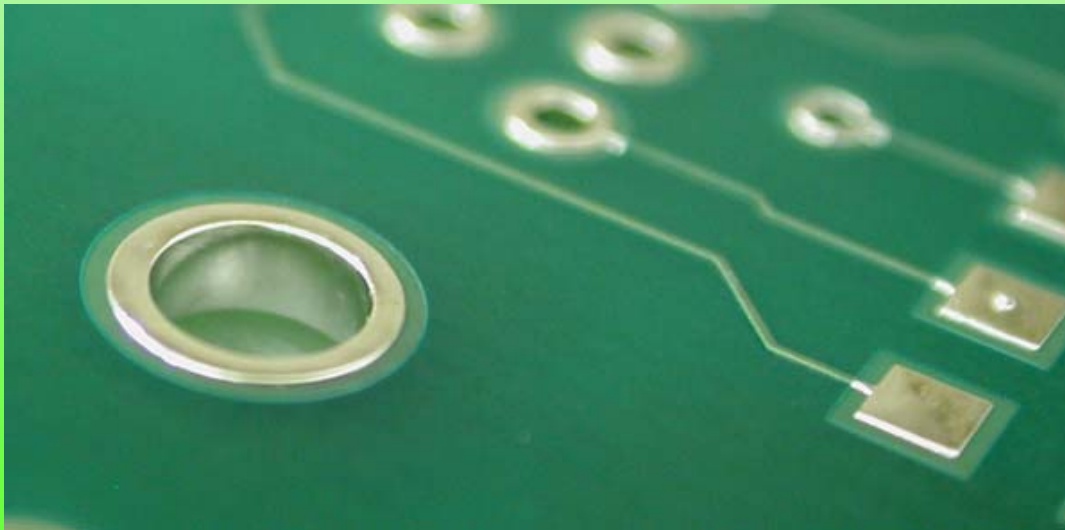
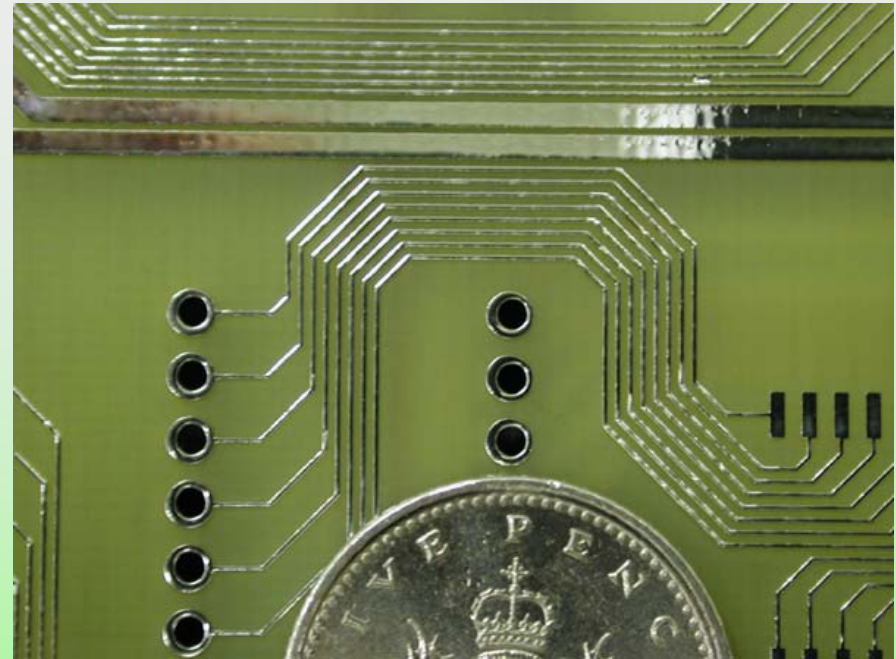
Differences in surface finish characterised by lead-free alloy type



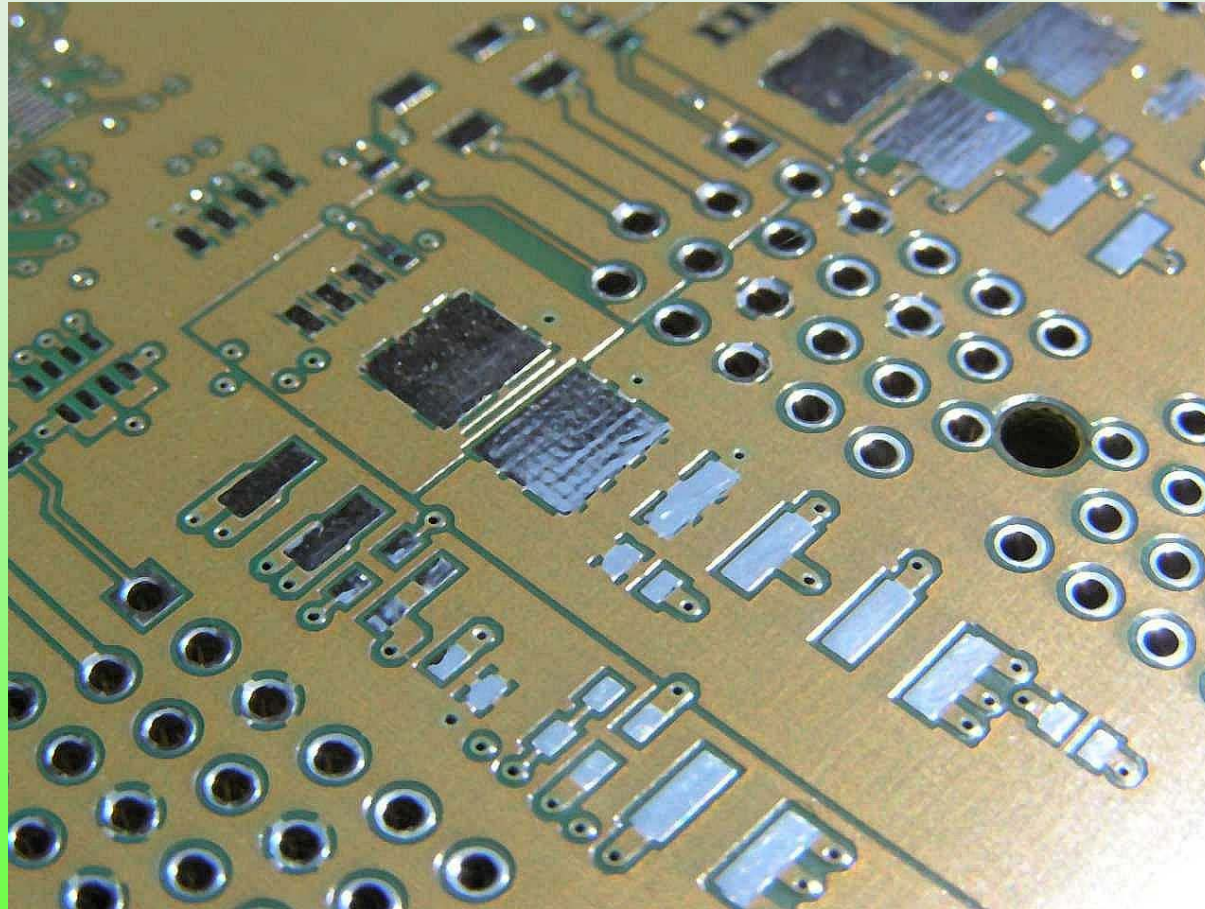
Examples of typical finishes for three different Lead-Free alloys HASL coated over bare copper laminate



Examples of lead free HASL



Example of lead free HASL



Example of lead free HASL

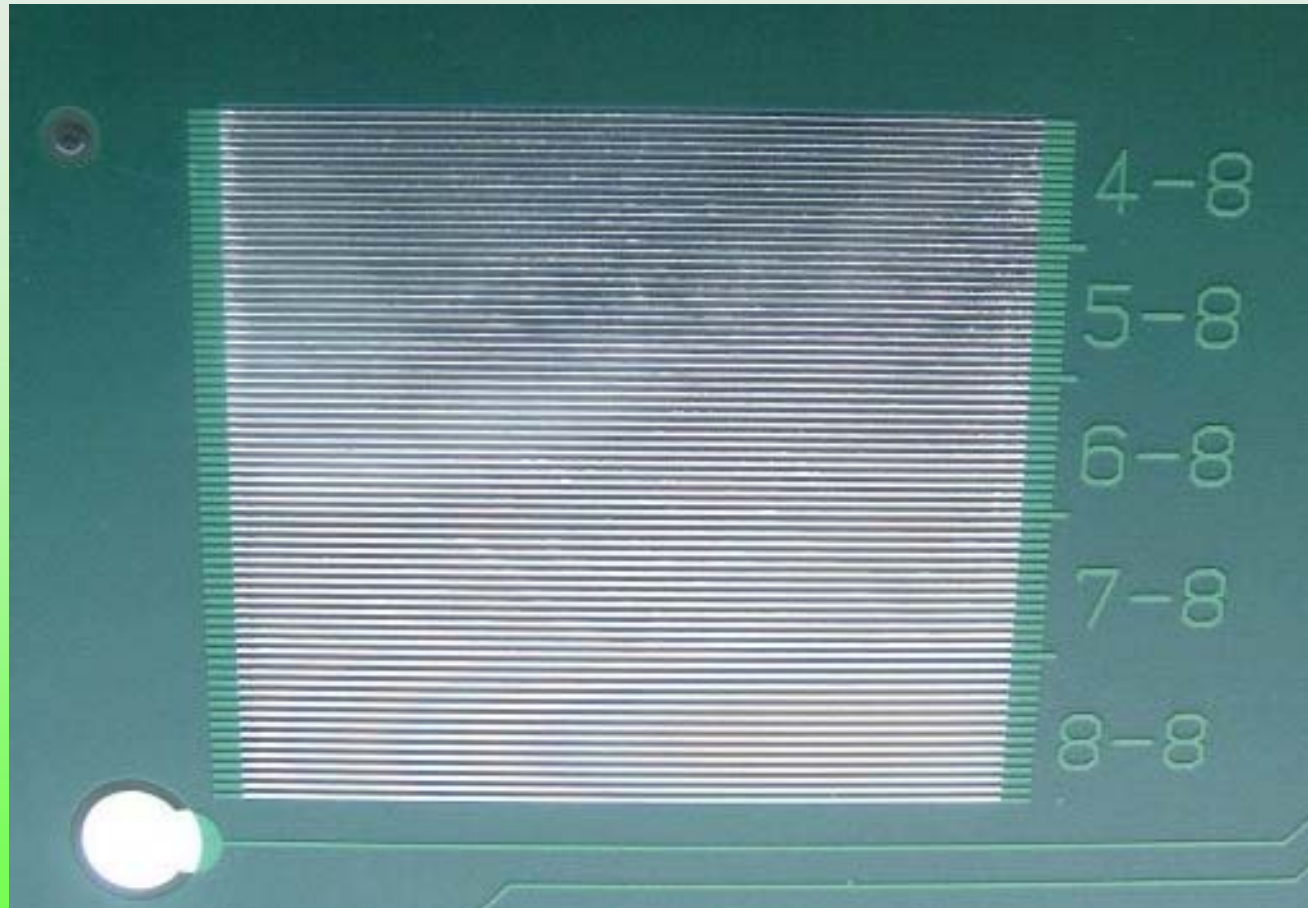


1.78-4.03 μm

1.4-2.85 μm

2.17-4.79 μm

Fine pitch work with lead free HASL



0.2mm wide tracks 0.1 - 0.2mm spaces

Overall Uniformity

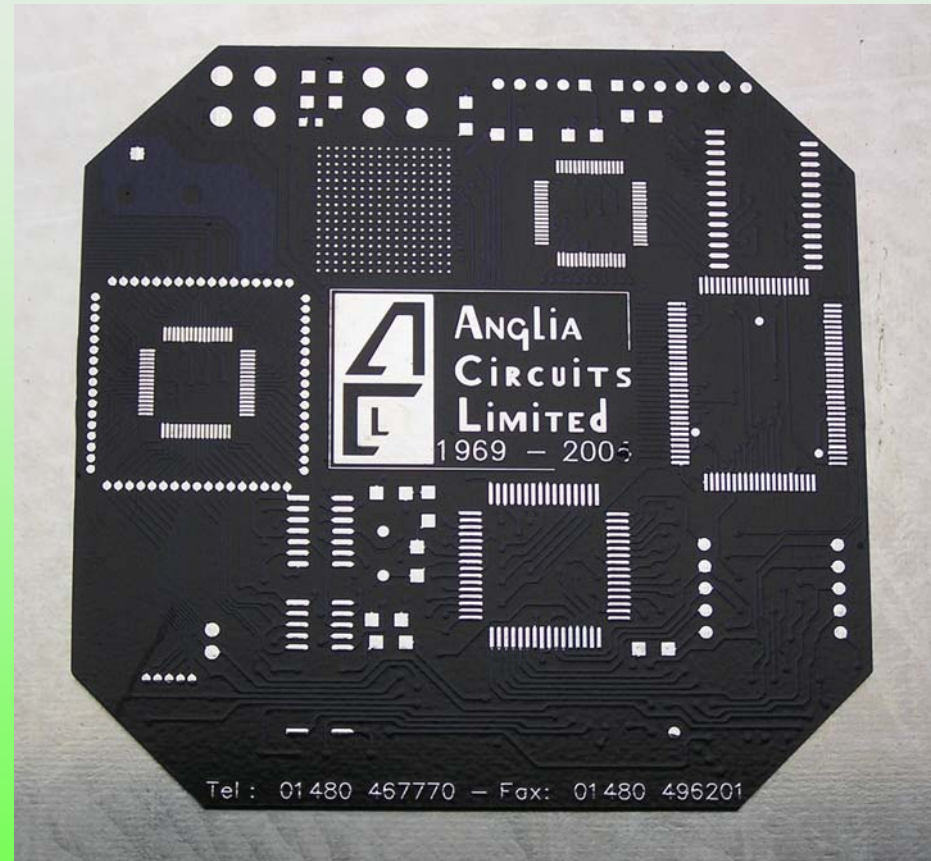
XRF thickness data
across ALL features

2.0 μm minimum

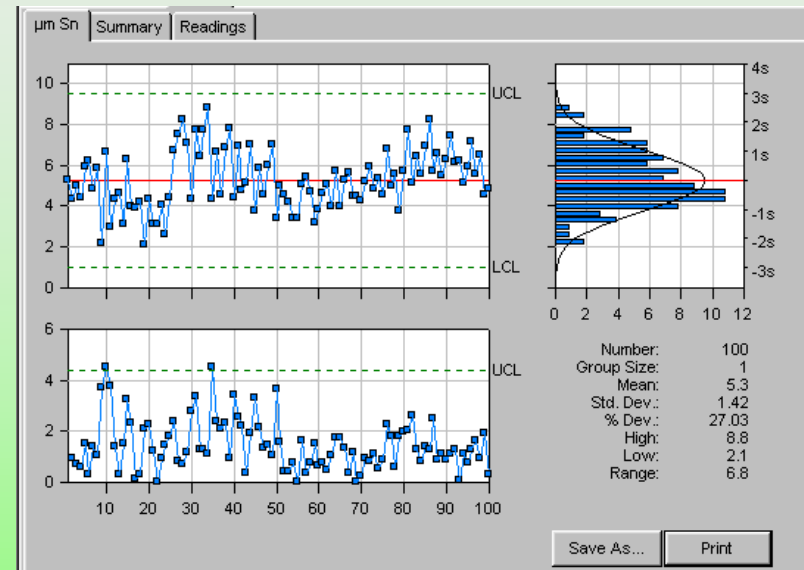
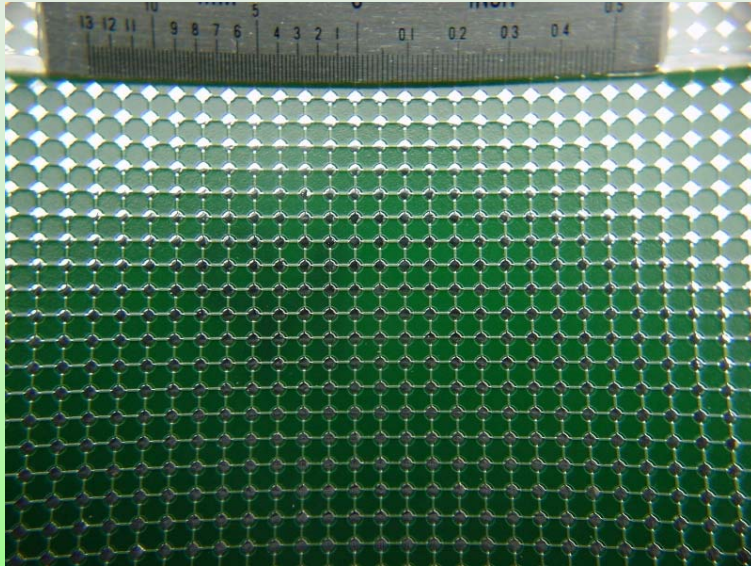
3.65 μm mean

10.86 μm maximum

Test piece leveled on
Quicksilver lead-free
machine



Grid array feature (0.5mm pads)



XRF READINGS

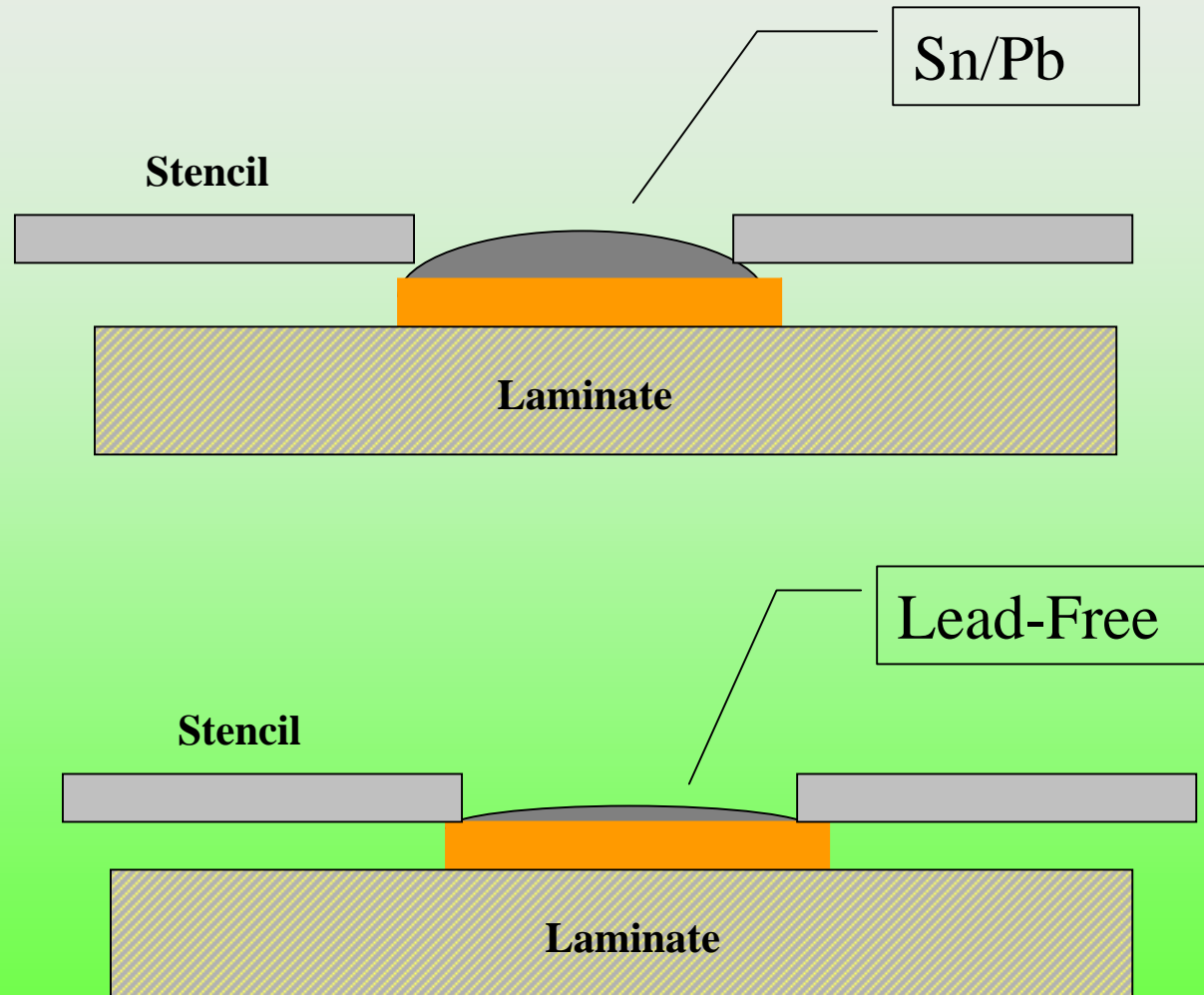
2.1 µm minimum

5.3 µm mean

8.8 µm maximum

Advantage of greater thickness control

Sketch showing improved gasket sealing during solder paste printing on fine features.



Advantages of Lead-free HASL

- Total solder wetting of the copper substrate prior to assembly

(No other PCB finish achieves this fundamental operation)

- The ultimate QA tool- the process highlights material and manufacturing defects on the bare board, prior to assembly
- Robust surface finish
- Long Shelf Life
- High Throughput process



Horizontal Alchemy line

JULY 1st 2006



Vertical Quicksilver