# Finishes

## 1. Introduction

Until a few years ago, there was scarcely any discussion about the surface finish of printed circuit boards. Solder applications used hot air levelling finishes, bonding or connector applications used Ni/Au (electroless or electroplated).

Apart from the RoHS regulations, effective since 01.07.2006, it is increasingly the changing technical requirements on printed circuit boards which are driving the discussion about alternative finishes. Even if an increasing fraction of connections use alternative technologies, the main technology for connections in module manufacture will continue to be soldering.

contag has addressed this challenge and can basically offer almost all of these finishing variants.
The question is not which alternatives we can offer, but which alternative you need!

We would thus like this technology information sheet to be seen as something to help our customers make decisions.

## 2. Requirements on a universal finish

The increasing functional density of electrical modules requires the grid dimensions for printed circuit boards to be reduced more & more. In addition, changing technical requirements and new component assembly processes as well as the combination of differing techniques (e.g. COB and SMT) are placing high requirements on the performance of contact surfaces on printed circuit boards.

In parallel to this the requirements on the basic material are increasing, which must have improved temperature-dependent characteristics and dimensional stability for multiple soldering processes with a higher temperature profile.

- The characteristics of a universal printed circuit board finish: Support fine structures
- The pad planarity
- Solderable, even several times and selectively at higher temperatures
- Bondable
- Suitable for press-fit technology
- Environmentally compatible
- Cost effective

## 3. The alternatives to a lead free HAL finish

When considering the restrictions, the following finishes are recommended:

Lead-free HAL, electroless tin, electroless nickel/gold, electroless nickel/palladium/gold, electroless silver, organic copper passivisation

### 3.1 Electroless tin

- Deposit of electroless tin layer from a minimum of about 0.6 µm to max. 2 µm
- Soldering is either possible with this thin layer or by applying solder paste using a template or a dispenser

Advantages:
- High planarity of component pads
- Very good solderability
- Good corrosion protection for the underlying copper

Disadvantages:
- No metallic bonding to the copper layer
- Narrow process window for soldering
- Uses thiourea - a process which is not good for the environment
- Limited storage time due to thin layer (≤ 6 months)

### 3.2 Electroless nickel/gold

- Apart from complete nickel/gold plating, the use of a suitable solder resist makes selective plating possible

Layer combinations:
- 3-7 µm Ni; 0.06 - 0.1 µm electroless gold (solder and US Al wire bonds)
- 3-7 µm Ni; 0.3 - 0.7 µm electroless thick gold (solder and TS Au wire bonds)

Advantages:
- Good solderability
- Very good bonding characteristics
- Stores well (> 12 months)

Disadvantages:
- Restrictions with differing base materials (e.g. PTFE)
- High process temperatures (electroless Ni approx. 90° C for approx. 20 min.)
- Surface sensitive to impurities
- Rework not possible if surface is damaged

### 3.3 Electroless nickel/palladium/gold

Layer combinations:

4-7 µm Ni/approx. 0.3 µm Pd/ approx. 0.01µm Au (Al & Au wire bonds, solder)4-7 µm Ni/ approx. 0.05 µm Pd/ approx. 0.06 µm Au (Al & Au wire bonds, solder)Advantages:

- Wide application for variety of component assembly and connection processes
- Relatively large process window
- Good for storage (at least 12 months)
- Very planar surface

Disadvantages:

- High costs
- Surface sensitive to impurities

### 3.4 Electroless silver

- Electroless silver plating of component pads
- If a suitable solder resist system is used, both full and selective silver plating is possible
- Layer thickness: 0.15 - 0.3 µm with corrosion inhibitor

Advantages:

- Very good solderability (especially with lead-free soldering)

Very good bonding characteristics(US bonding process) Very planar surfacesLow process temperatures (approx. 45 - 50°C)Cost effectiveDisadvantages:

- Despite all of its positive aspects is not much used
- Special storage requirements (airtight)
- Long term reliability disputed

### 3.5 Organic copper passivisation (OSP)

- Organic passivisation (OSP) of copper surfaces using imidazoles and triazoles
- Brand names such as EntekPlus, Glicoat, Mecseal or Schercoat
- Layer thickness: 0.2 - 0.5 µm

Advantages:

- High planarity of component pads
- Good for storage (max. 12 months)
- Cost effective surface for solder processes

Disadvantages:

- Multiple soldering only possible under certain conditions
- Solder parameters have to be modified
- Use at high solder melting temperatures not yet tested
- Not bondable

### 3.6 HAL lead-free / HAL PbSn

- In the well-known HAL process, either lead-free or conventional SnPb solder is applied.

Advantages:

- Very good solderability
- Low process temperatures
- Well known reliability and long term performance

Disadvantages:

- Limited suitability for fine pitch
- Not bondable
- Poor planarity

## 4. The conductive surfaces in a quick comparison

| Process / Requirement | HAL | Electroless Sn | Electroless Ni/Au | Electroless Pd | Electroless Ag | OSP | HAL PbSn |
|---|---|---|---|---|---|---|---|
| Suitability for fine pitch | 4 | 1 | 1 | 1 | 1 | 1 | 4 |
| Coplanarity | 5 | 1 | 1 | 1 | 1 | 1 | 5 |
| Solderability | 1 | 1-2 | 1-2 | 1 | 1 | 2 | 1 |
| Multiple soldering | 1 | 2-3 | 2-3 | 1-2 | 1-2 | 3-4 | 1 |
| Bondability | 5 | 5 | 1 | 1 | 1-2 | 5 | 5 |
| Contact surface for keyboards | 5 | 5 | 1 | 1 | 5 | 5 | 5 |
| Reliability of modules | 2<br>According to available test results | 2 | 2 | 2 | 2 | 2 | 2 |

1) very good, 2) good, 3) satisfactory, 4) restricted, 5) unsuited

contag offers all of the conductive finishes shown in the overview.

For further technological questions concerning circuit boards, please contact our team of technologists (Tel. 030/351 788 – 155).