



## Technology information

### 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. 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 passivation

##### 3.1 HAL lead-free

- In the well-known HAL process.

##### Advantages:

- Very good solderability
- Well known reliability and long term performance

##### Disadvantages:

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

##### 3.2 Electroless tin

- Deposit of electroless tin layer from a minimum of about 0.6  $\mu\text{m}$  to max. 2  $\mu\text{m}$
- 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)



### 3.3 Electroless nickel/gold

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

#### Layer combinations:

- 3-7  $\mu\text{m}$  Ni; 0.06 - 0.1  $\mu\text{m}$  electroless gold (solder and US Al wire bonds)
- 3-7  $\mu\text{m}$  Ni; 0.3 - 0.7  $\mu\text{m}$  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.

### 3.5 Electroless silver

#### Layer combinations:

- 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  $\mu\text{m}$  with corrosion inhibitor

#### Advantages:

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

Very good bonding characteristics (US bonding process) Very planar surfaces Low process temperatures (approx. 45 - 50°C) Cost effective

#### Disadvantages:

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

### 3.7 HAL PbSn

In the well-known HAL process

#### Advantages:

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

#### Disadvantages:

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

### 3.4 Electroless nickel/palladium/gold

#### Layer combinations:

- 0.1  $\mu\text{m}$  Pd directly on Cu (solder, press-fit, glue)
- 0.5  $\mu\text{m}$  Pd + 0.1  $\mu\text{m}$  Au on Cu (TS wire bond)
- 0.1  $\mu\text{m}$  Pd on Ni (reflow solder)
- 0.2  $\mu\text{m}$  Pd on Ni (US wire bond and solder)
- 0.5  $\mu\text{m}$  Pd on Ni + 0.04 - 0.1  $\mu\text{m}$  Au (solder and bond)

#### 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

### 3.6 Organic copper passivisation (OSP)

- Organic passivisation (OSP) of copper surfaces using imidazoles and triazoles
- Brand names such as EntekPlus, Gliccoat, Mecseal or Schercoat
- Layer thickness: 0.2 - 0.5  $\mu\text{m}$

#### 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



#### 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 key-boards	5	5	1	1	5	5	5
Reliability of modules	2	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).