



epec

ENGINEERED TECHNOLOGIES

▶ **SURFACE FINISHES**

Epec Technical Webinar

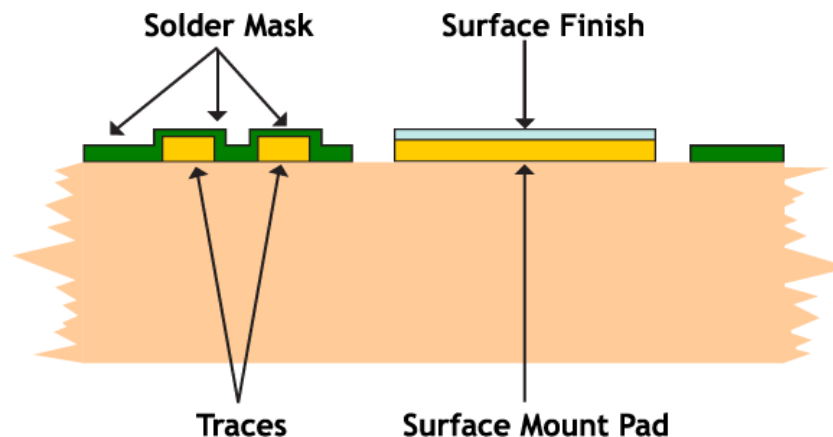
▶ **DELIVERING QUALITY SINCE 1952.**

► Overview:

The printed circuit board surface finish forms a critical interface between the component to be assembled and the bare PCB. The surface finish has two essential functions:

- To protect the exposed copper circuitry.
- To provide a solderable surface when assembling (soldering) the components to the PCB.

Most surface finishes are considered SMOBC (Solder Mask Over Bare Copper).



▶ **Factors When Choosing Finish:**

- Cost
- RoHS \ WEEE \ ELV
- Assembly Method
- Components Used
- Durability
- Environment
- Shelf Life
- Testability
- Productivity
- Failures

▶ **Element Symbols:**

Copper	Cu
Gold	Au
Silver	Ag
Tin	Sn
Nickel	Ni
Lead	Pb
Carbon	C
Germanium	Ge
Palladium	Pd

▶ **Surface Finishes Covered:**

- HASL
- Lead Free HASL
- Immersion Tin
- Immersion Silver
- OSP / Entek
- Gold
 - ENIG
 - Hard Gold
 - Wire Bondable Gold

▶ HASL / Lead Free HASL:

Two Different Metals – Same Finish

- HASL (Standard): Typically Tin-Lead
- HASL (Lead Free): Typically Tin-Copper, Tin-Copper-Nickel, or Tin-Copper-Nickel Germanium.

Typical thickness: 70 micro inch – 200 micro inch, however IPC spec calls for only complete coverage of copper pads.

Advantages:

- ▶ Low cost
- ▶ Widely Available
- ▶ Reworkable

Disadvantages:

- ▶ Uneven surfaces
- ▶ Not good for fine pitch
- ▶ Pb
- ▶ Thermal shock
- ▶ Solder Bridging
- ▶ Plugged or reduced PTH's

Process Flow 

Clean	Microetch	Apply Flux	Solder Dip	Air Knife Leveling	Rinsing
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Typically Processed in Production Panel Form

▶ Immersion Tin:

Typical thickness: 20 micro inch –50 micro inch.

Advantages:

- ▶ Flat Surface
- ▶ No Pb
- ▶ Reworkable

Disadvantages:

- ▶ Easy to cause handling damage
- ▶ Process uses a carcinogen (Thiourea)
- ▶ Exposed tin on final assembly can corrode
- ▶ Tin Whiskers
- ▶ Not good for multiple reflow/assembly processes
- ▶ Difficult to measure thickness

Process Flow



Typically Processed in Production Panel Form

▶ **OSP / Entek**

Organic Solderability Preservative

Typical thickness: 4 micro inch – 24 micro inch; however not usually specified.

Advantages:

- ▶ Flat Surface
- ▶ No Pb
- ▶ Simple Process
- ▶ Reworkable

Disadvantages:

- ▶ No Way to Measure Thickness
- ▶ Not Good for PTH
- ▶ Short Shelf Life
- ▶ Can Cause ICT Issues
- ▶ Exposed Cu on Final Assembly
- ▶ Handling Sensitive

Process Flow



Typically Processed In 1-up or Array Form

▶ **Gold – ENIG**

Electroless Nickel Immersion Gold

***IMPORTANT** - The gold serves as a barrier and protectant to the nickel. The gold will dissolve into the solder during assembly. Gold thicknesses over 4 micro inches can cause solderability issues.

Typical thickness:

- Nickel: 100 micro inch – 200 micro inch
- Gold: 2 micro inch – 4 micro inch

Advantages:

- ▶ Flat Surface
- ▶ No Pb
- ▶ Good for PTH
- ▶ Long Shelf Life

Disadvantages:

- ▶ Expensive
- ▶ Not Reworkable
- ▶ Black Pad/ Black Nickel
- ▶ Damage from ET
- ▶ Signal Loss (RF)
- ▶ Complicated Process

Process Flow 

Clean	Microetch	Catalyst	Electroless Nickel	Rinse	Immersion Gold	Rinse
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Typically Processed In 1-up or Array Form

▶ **Gold – Hard Gold**

A.K.A: Flash Gold, Electrolytic Gold, Full body Hard Gold, Tab Gold, Selective Gold

***IMPORTANT** - Electrolytic process, all copper surfaces to be plated must be electrically connected to a rectifier (power supply), unless “gold as etch resist” process is used. Unplated copper must be covered by mask or resist. Gold has grain stiffeners and brighteners added.

Typical thickness:

- Nickel: 125 micro inch – 150 micro inch
- Gold: 25 micro inch – 40 micro inch

Advantages:

- ▶ Hard, Durable Surface
- ▶ No Pb
- ▶ Long shelf life

Disadvantages:

- ▶ Very Expensive
- ▶ Extra Processing / Labor Intensive
- ▶ Use of Resist / Tape
- ▶ Plating / Bus Bars
- ▶ Demarcation
- ▶ Difficulty with other Surface Finishes

Process Flow



Apply Resist/Tape	Clean	Micoreetch	Electroless Nickel	Rinse	Electrolytic Gold	Rinse	Strip Resist/Tape	Clean
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Typically Processed in Production Panel Form

▶ **Gold – Wire Bondable Gold**

Typically uses Electrolytic Nickel / Gold processing; however gold must not have added grain stiffeners or brighteners. Nickel hardness is important.

Two Types of Wire Bonding: Aluminum Wedge and Ultrasonic (Thermal)

Welding Aluminum Wedge:

Typical thickness:

- Nickel: 100 micro inch – 200 micro inch
- Gold: 5 micro inch – 15 micro inch

Ultrasonic (Thermal) Welding:

Typical thickness:

- Nickel: 100 micro inch – 200 micro inch
- Gold: 45 micro inch – 60 micro inch

► Summary Matrix

	Cost	RoHS	Typical Thickness	Processing
HASL	\$	No	Pad Coverage	Panel
Lead Free HASL	\$	Yes	Pad Coverage	Panel
Immersion Tin	\$	Yes	20-50 ui	Panel
Immersion Silver	\$\$	Yes	4-12 ui	1-up / Array
OSP/Entek	\$\$	Yes	4-24 ui	1-up / Array
Immersion Gold	\$\$\$	Yes	Nickel: 100-200 ui Gold: 2-4 ui	1-up / Array
Hard Gold	\$\$\$\$	Yes	Nickel: 125-150 ui Gold: 25-40 ui	Panel

**For More Information Please Contact
Christopher Perry at 508.995.5171 Ext. 202
cperry@epectec.com**