Test Report Pentagal

Test with Cookson SACX® alloy for the HASL process

1. Introduction

From 16.05.06 untill 16.09.06 a long term test was carried out at **PENTAGAL Chemie und Maschinenbau GmbH** with the Cookson Electronics HASL *SACX*® alloy. All production tests were carried out in a PENTA AUTOMATIC. Main goal of these long term production tests was to test the application and compatibility of this alloy for HASL application in the PENTA machines. The following parameters were investigated:

- Solderability
- Surface Quality
- Alloy behaviour

The first make up contained 0,04% Nickel but the content dropped to 0,005% through replenishment of nickelfree alloys. In order to check the above parameters as a function of the nickel content, the concentration was increased stepwise to 0,015% during the second part of the test period

2. Operating Parameters

The operating parameters were set as per following table. The exact settings of the parameters were dependant on the size, thermal mass and thickness of the boards

	Pentagal	Units
Solder Temperature	270 - 277	°C
Total Contact Time Top	2,5 – 5,0	sec
Total Contact Time Bottom	2,8 – 7,6	sec
Air Pressure Front	36,3-42,1 (2,5 – 2,9)	psi (bar)
Air Pressure Back	34,8-40,6	psi
Knife Gap	0,2	mm
Knife off Set	1,5 – 4,5	mm
Knife Temperature *	370	°C
Insertion Speed	50	$cm\ s^{-1}$
Withdrawal Speed	25	$cm\ s^{-1}$

* Airheater Temperature (≈ Air Temperature)

3. Solderability

The SACX alloy in general is operating well. No wetting problems have been observed at all when the process was operated within the required parameters. It was also noticed that this alloy has a very wide operating window, speciall in relation to copper build up and process temperature. All SMT pads were fully wetted even in the corners of the pads (Fig. 1).

The viscosity and wetting behaviour and as a result the blow off characteristics of the alloy showed a slight dependancy on the Nickel content which was at optimum at 0,025%. At concentrations lower than 0,01% an increase in viscosity resulted sometimes inless uniformity of the pads and the shinyness became slightly less. Nevertheless this has no negative effect on solderability performance (Fig *2,3,4)*.
Uneven copper surfaces were very well leveled with the SACX alloy.

This was very well demonstrated in the pinholes, which were very smooth after blowing off (fig 5,6). The SACX deposit was on the complete hole wall not less than 2 um

4. Surface Quality

The good wetting performance of this solder alloy resulted in very smooth surfaces which gave a semi glossy appearance. With very thick boards, which were cooled down much slower due to the heat storage in the mass copper areas, sometimes a slight yellowish colour was observed but this has no negative effect on solderability.
The laminar unevenness with the small as well as some bigger pads on the blow off side (Fig 1-4) were not related to the SACX alloy.

5. Process behaviour

As mentioned earlier the SACX tin bath was during the tested period (4 months production) very stable. The dissolvation of copper measured was at maximum 4 um but very dependant on the immersion time, board thickness and copper content of the alloy (Fig 7). The increased copper content in the alloy has to be regularly removed by freezing out of the IMC compound Cu6Sn5.
This is achieved by reducing the temperature of the alloy just under liquidus temperature, preferably for a prolonged time (overnight) (Fig 8). The effectiveness of this process is dependant on the crystallization behaviour and the formed needles (shape and form dependant on alloy composition).
The longer and thicker needles are very easy to remove from the alloy without dragging out too much SACX alloy attached. On the other hand the smaller needled sometimes leads to dragout of good alloy material. An increase in nickel results in smaller needles (Fig 9).

6. Summary

At **PENTAGAL Chemie und Maschinenbau GmbH** a 4 month HAL production test (real production boards) was carried out in a **PENTA AUTOMATIC** with the *SACX® alloy from* **Cookson Electronics**. During the whole period of testing this alloy was very easy to operate and showed a remarkable wide process window concerning process Temperature and alloy composition. Even at the lower end of the temperature window the leveling and brightness of the alloy was very satisfactory. The viscosity and as a result the wetting behaviour and blow off characteristics ie thickness on the pads showed some relation the nickel content in the process as well as on the formation of the freeze out of IMC needles. .
Vaculoy SACX from Cookson with it's wide process window is a very good HAL alloy and is compatible with PENTA HAL equipment.

7. Photo;s

At the enclosed pictures is the blow off direction allways from top to bottom

Fig.. *5 – 7 were investigated with light microscope with crossed polarization filters*

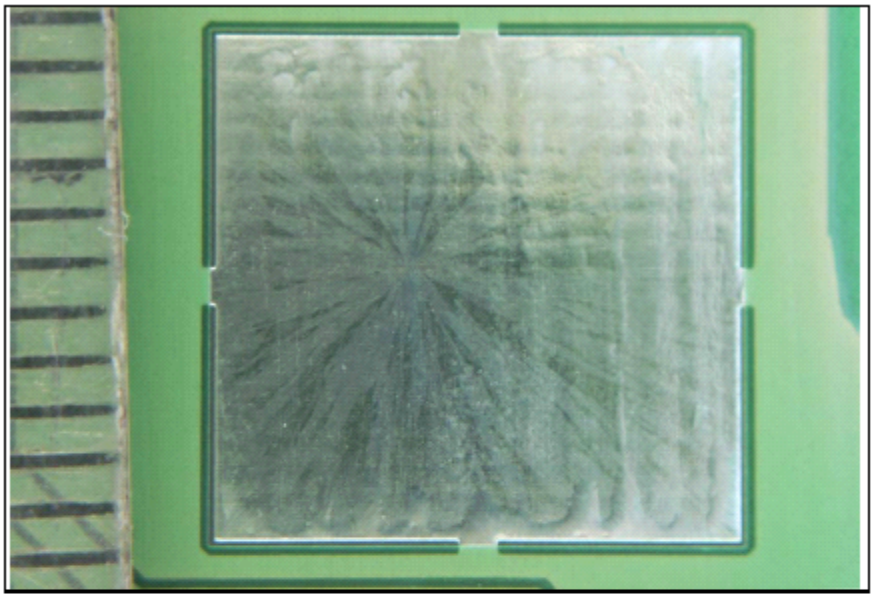

Abb. 1: Padoberfläche

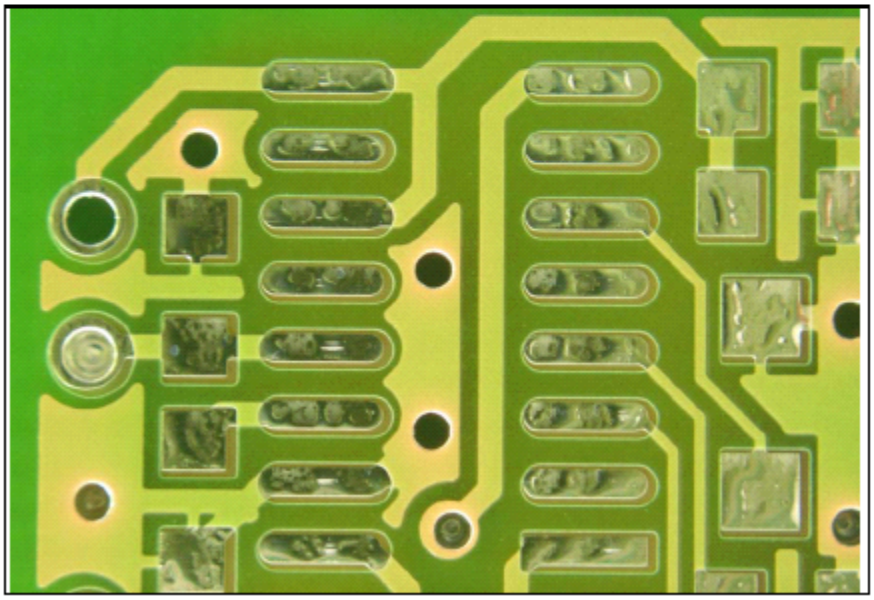

Abb. 2: Ni-Gehalt gering

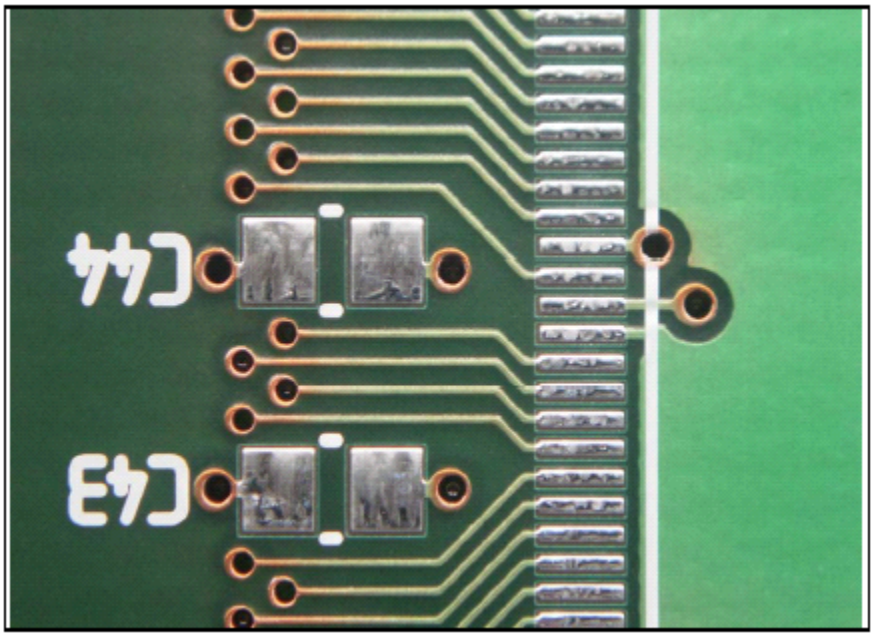

Abb. 3: Ni-Gehalt gut

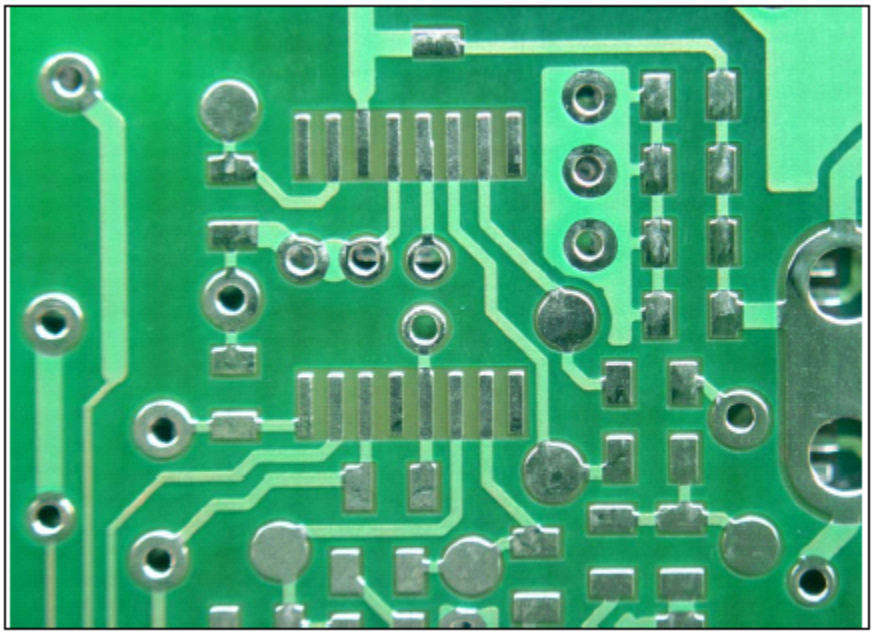

Abb. 4: Ni-Gehalt hoch

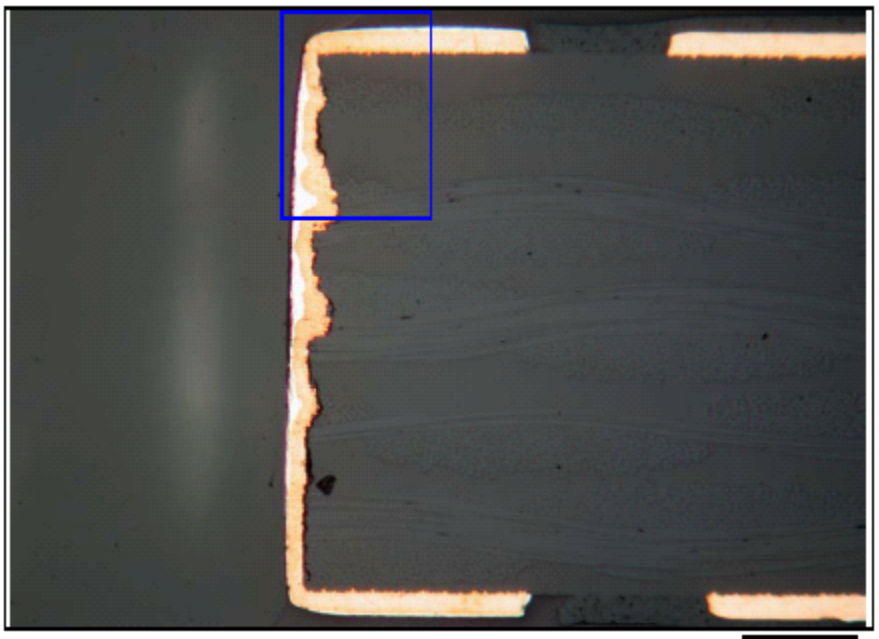

Abb. 5: Flanke eines Pinholes. Der Rahmen markiert den Bereich der Abb. 6

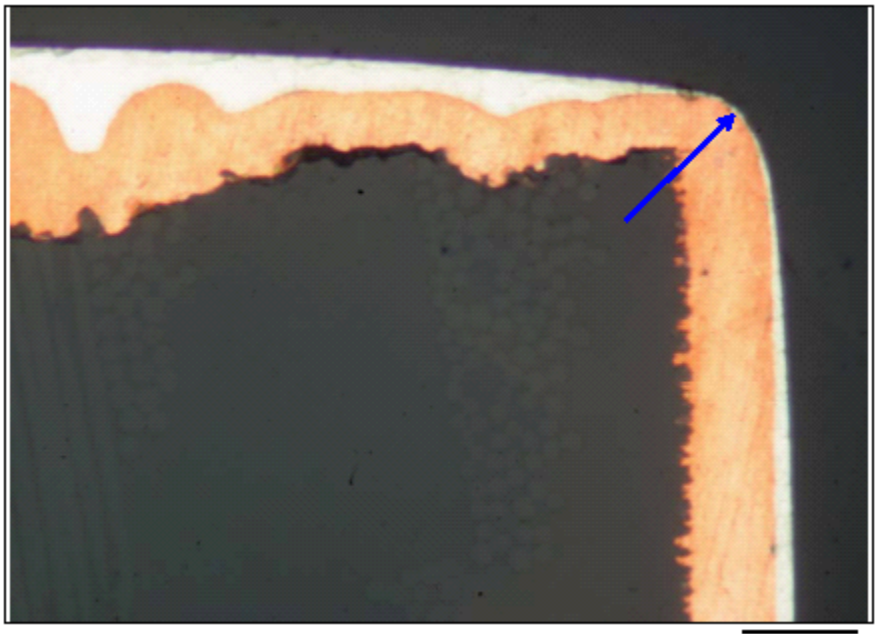

Abb. 6: Detail aus Abb. 5 um 90°gedreht.

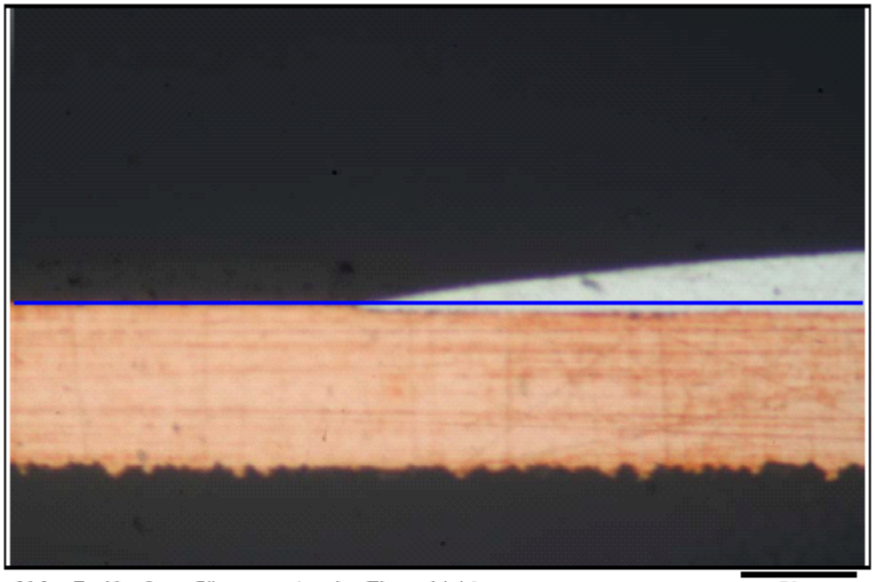

Abb. 7: Kupferauflösung unter der Zinnschicht.
Die blaue Linie markiert das ursprüngliche Niveau der Kupferoberfläche

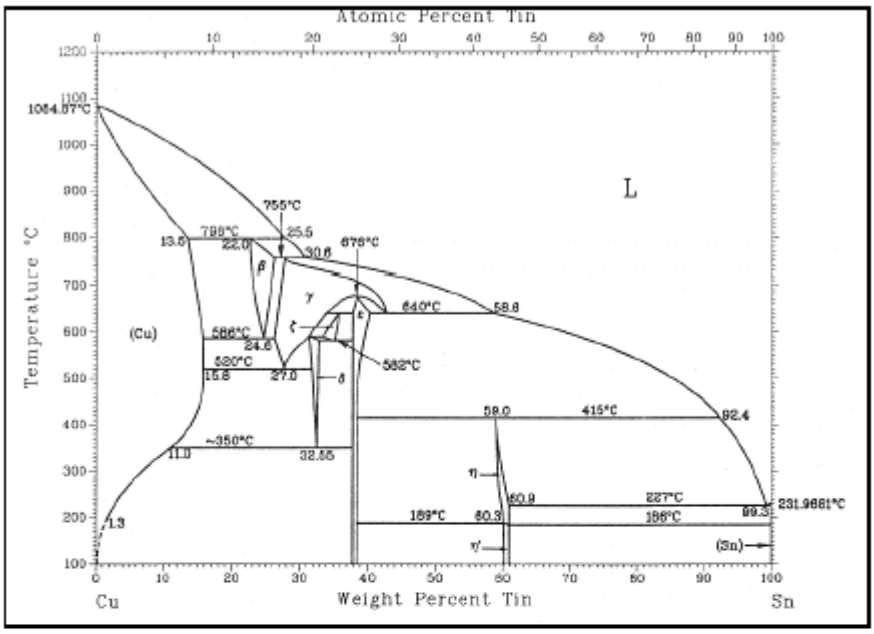

Abb. 8

Zweistoffsystem Cu – Sn

oben : Gesamtsystem

rechts : Teilsystem.

Der Pfeil zeigt die Temperatur-absenkung bei der entspre-chenden Badzusammensetzung

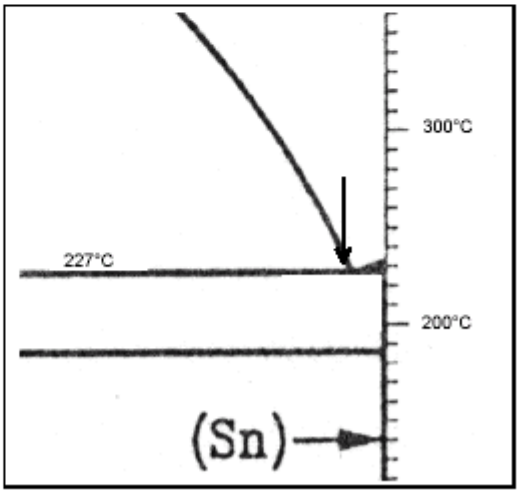

Abb. 9: Ausgefrorene Cu_6Sn_5-Nadeln

oben links : 0,008% Nickel
oben rechts : 0,025% Nickel
unten rechts : 0,045% Nickel