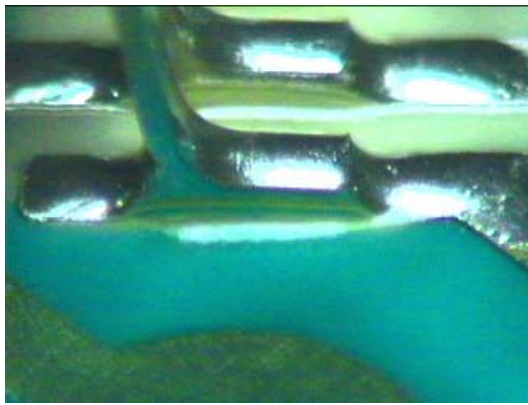
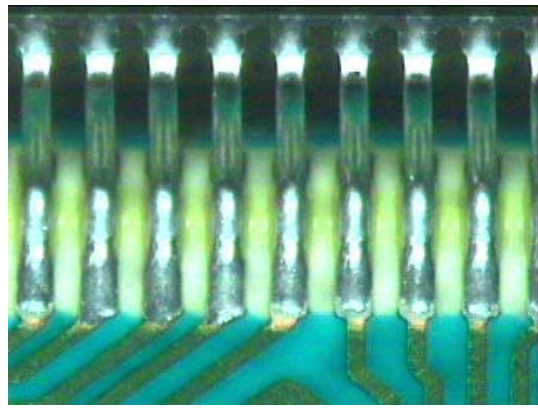
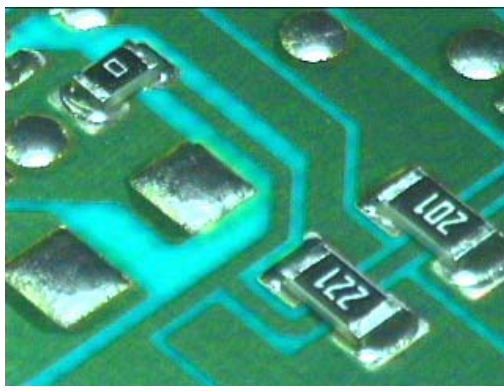
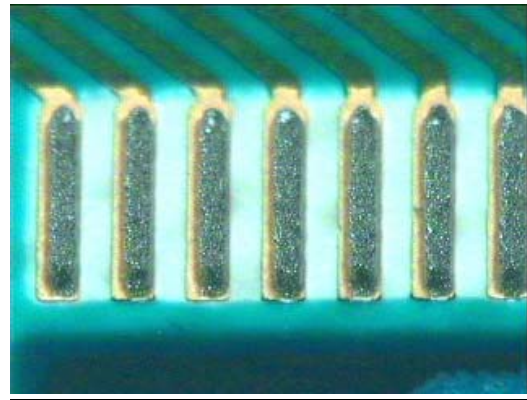




# "ORION™ 410" No-Clean Solder Paste

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# "ORION™ 410" No-Clean Solder Paste

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# "ORION™ 410" No-Clean Solder Paste

## I) INTRODUCTION:

ORION™ 410 No-Clean solder paste is carefully formulated to solder difficult surfaces and let yet a very low volume of clear residues after soldering.

This paste is designed to offer a wide process window and reduces solder defects. The flux system is long life, reduces paste waste and costs.

The residues are non-corrosive and completely benign. The solder paste meets the international test standards.

This paste is available in lead-free options and has an extended shelf life of 1 year.

Tests and Qualifications include criteria from the J-STD-004, -005, and -006 specifications (IPC-TM-650 tests methods).

## II) PRODUCT PROFILE:

Alloy	Sn62Pb36Ag2	Sn63Pb37	Sn95.5Ag3.8Cu0.7
Particle size for grade 3	25-45 µm 1 to 1.8 mil	25-45 µm 1 to 1.8 mil	25-45 µm 1 to 1.8 mil
Application	Fine-Pitch (400µm) (15.75 mil) Ultra Fine Pitch in grade 5	Fine-Pitch (400µm) (15.75 mil) Ultra Fine Pitch in grade 5	Fine-Pitch (400µm) (15.75 mil) Ultra Fine Pitch in grade 5
Melting point "Eutectic"	179°C	183°C	217°C
Metal content	89.5 to 90.2 %	89.5 to 90.2 %	89.5 to 90.2 %
Viscosity	700–1000 Pa.s	700–1000 Pa.s	700–1000 Pa.s
Shelf life (5 to 10°C in jar)	12 month	12 month	12 month
Stencil life	>24 hours	>24 hours	>24 hours
Print speed	Up to 150 mm/s ( 6" /s)	Up to 150 mm/s ( 6" /s)	Up to 150 mm/s ( 6" /s)
Tack life	> 96 hours	> 96 hours	> 96 hours
Slump resistance	> 20mn at 80°C	> 20mn at 80°C	> 20mn at 80°C

Other standard alloys available on request.



# "ORION™ 410" No-Clean Solder Paste

## III) PHYSICAL AND APPLICATION TESTS – PASTE PERFORMANCE:

According to J-STD 004, 005, 006 and IPC-TM-650 tests methods.

III-1	Classification
III-2	Solder powder particle size
III-3	Metal content
III-4	Viscosity, Malcom profile
III-5	Shelf life
III-6	Printing Test – Speed
III-7	Stencil life – Abandon time
III-8	Tack life
III-9	Slump resistance
III-10	Solder balling test
III-11	Wetting test
III-12	Reflow capabilities

## IV) RELIABILITY TESTS:

IV-1	Copper mirror
IV-2	Silver chromate
IV-3	Fluoride Spot
IV-4	Copper Corrosion
IV-5	Surface Insulation Resistance (SIR)
IV-6	Acid value
IV-7	Ionic contamination
IV-8	Bono test

## V) DELIVERY METHODS:

**PROFLOW 800g**

\*

**RHEO PUMP CARTRIDGES 500g 1Kg**

\*

**SYRINGES & CARTRIDGES of 30g 100g EFD, SEMCO, IWASHITA**

\*

**JARS, 250g, 500g, 1Kg**



# "ORION™ 410" No-Clean Solder Paste

## III-1 Classification:

Alloy Designation	Flux Classification	Powder Size Type	Nominal Metal Content	Viscosity
Sn62PbAg2	ROL0	25 – 45µm (1 to 1.8 mil)	89.5 to 90.2%	700- 1000 Pa.s

## III-2 Solder powder particle size and distribution:

- Powder classification: class 3
- Particle size: 25-45 µm (1 – 1.8 mil)
- See Appendix I: "QUALITY CERTIFICATE"

## III-3 Metal content:

### METHOD:

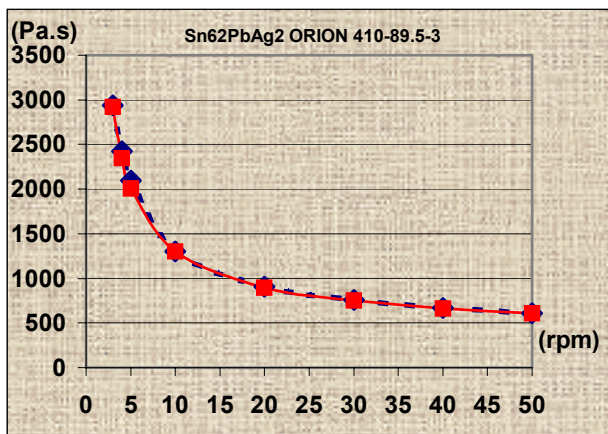
- Weigh 20g of paste into aluminium boat.
- Melt paste into a slug
- Weigh cleaned slug and express mass as % of paste.
- Test in duplicate
- Results: see summary



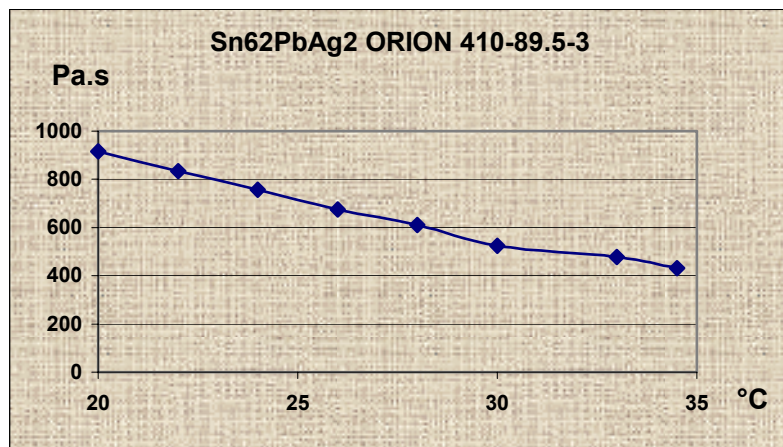
# "ORION™ 410" No-Clean Solder Paste

## III-4 Rheology:

### Malcom profile at regulated temperature: 25°C



### Viscosity v/s Temperature at 30 rpm:



(Malcom)

Temperature in °C	20	22	24	26	28	30	33	34.5	20
Viscosity in Pa.s	917	835	756	675	610	524	478	432	902



# "ORION™ 410" No-Clean Solder Paste

## III-5 Shelf-life:

ORION 410 has a shelf-life up to 12 months, stored at 5°C to 10°C. For dispensing grade version the shelf life is reduced to 6 months.

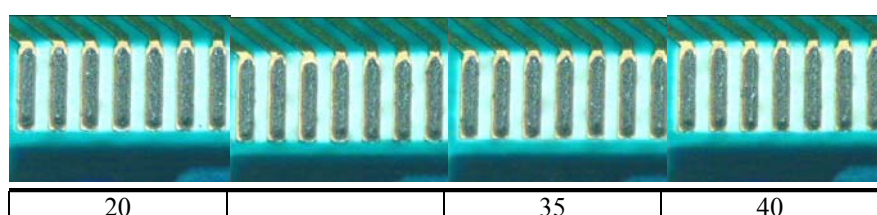
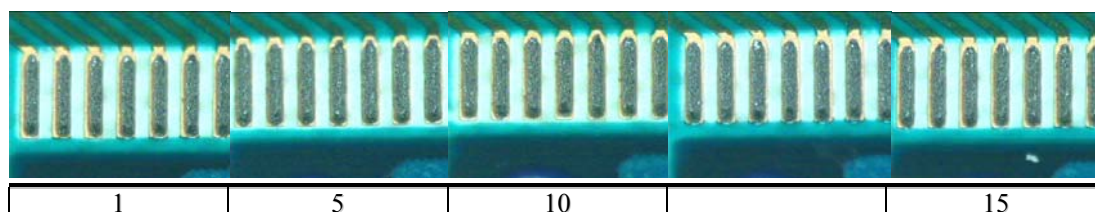
Stored at 5 to 10°C	0 Months	6 Months	12 Months
Viscosity (Brookfield)	710	740	740
Activity	< 3 micro-balls	< 3 micro-balls	< 3 micro-balls

## III-6 Printing test speed:

Performance verified on MPM, DEK, SM-TECH, EKRA.

Squeegee speed	Up to 150 mm/s	Generally slower for fine pitch
Best results	80 to 120 mm/s 3 to 5" /s	Down to 25 with lower pressure
Squeegee pressure	5 – 10 Kg	Generally higher for fine pitch
Wipe frequency	> 20 prints	At high squeegee speed

## Stencil cleaning: wipe frequency

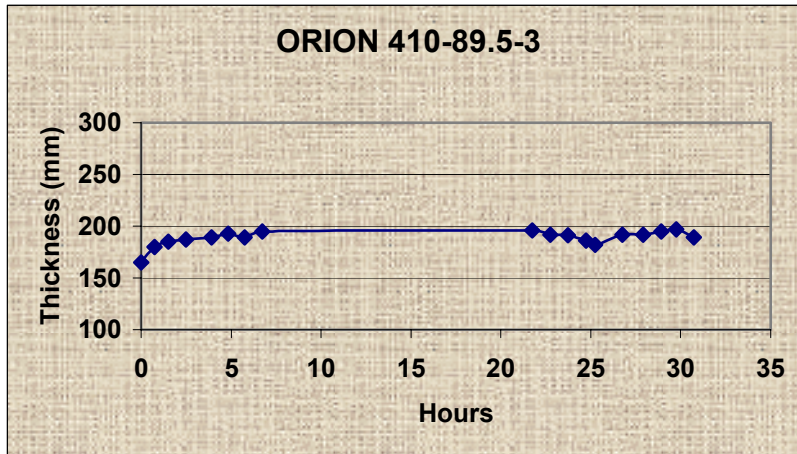


Without Stencil Cleaning  
after 40 printing Cycles.  
No defect detected.



# "ORION™ 410" No-Clean Solder Paste

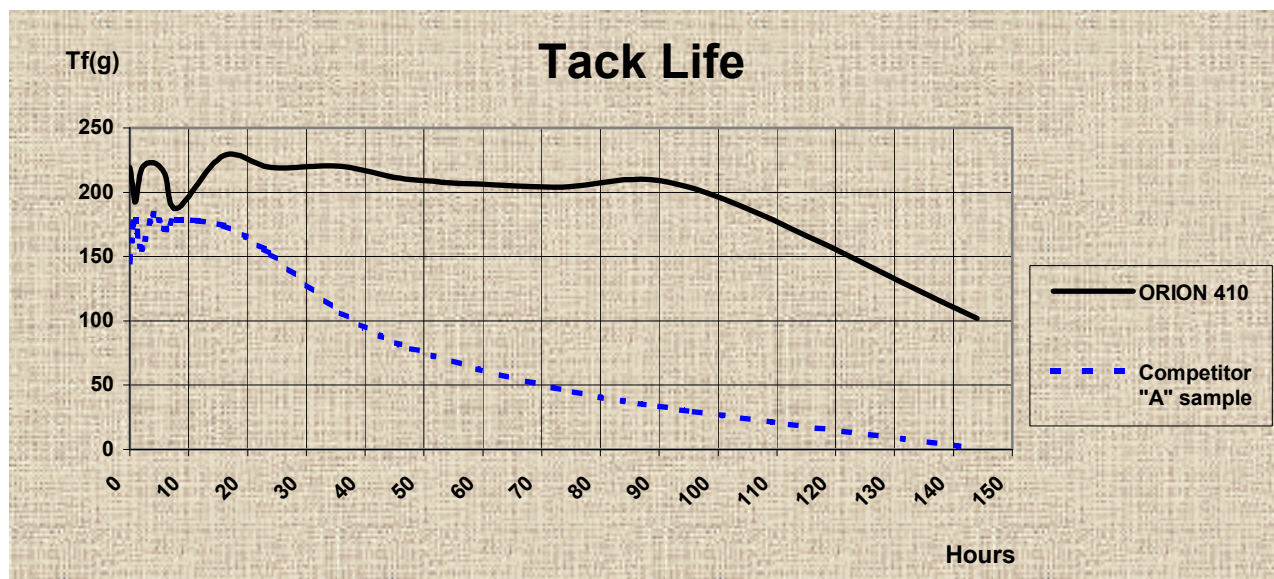
## III-7 Stencil life – Abandon time:



Abandon time is more than 30 hours at ambient conditions.

(25°C +/-5°C)  
(50% RH +/-10%)

## III-8 Tack-life:



The Tack Force is virtually unchanged for the first 96 hours.  
80% of the initial value is reached at around 120 hours (in accordance to J-STD-005).



**III-9 Slump resistance:**

**Slump resistance in accordance to IIW and J-STD-005 → Pass**

IIW	24 hrs @ 25°C / 50% RH	20 mn @ 80°C
Type I	0.2	0.2
Type II	0.2	0.2

Stencil IPC-A-20 (0.1 mm Thick)					
Pad size 0.33 x 2.03			Pad size 0.2 x 2.03		
Spacing mm	Hor.	Vert.	Spacing mm	Hor.	Vert.
0.45	NO	NO	0.30	NO	NO
0.40	NO	NO	0.25	NO	NO
0.35	NO	NO	0.20	NO	NO
0.30	NO	NO	0.175	NO	NO
0.25	NO	NO	0.15	NO	NO
0.20	NO	NO	0.125	NO	NO
0.15	NO	NO	0.10	NO	NO
0.10	NO	NO	0.075	NO	NO
0.08	NO	NO			

Paste did not exhibit any bridged pads for the entire slump test.

**SIEMENS Slump test**

	Requested	Results
Class 3 ( 150µm )	I ≥ 0.2 mm	0.2 mm
	II ≥ 0.3 mm	0.2 mm

(See Siemens report in appendix III)



# "ORION™ 410" No-Clean Solder Paste

## III-10 Solder balling test:

- On alumina substrate:

Test conditions:  $25\pm 2^{\circ}\text{C}$ ;  $50\pm 10\%\text{RH}$

Spherical nice regular form.  
No micro-balling observed after 4  
hours  
at ambient conditions.



t = 0 hour



t = 2 hours  
Satellites < 3



t = 4 hours  
Satellites < 3

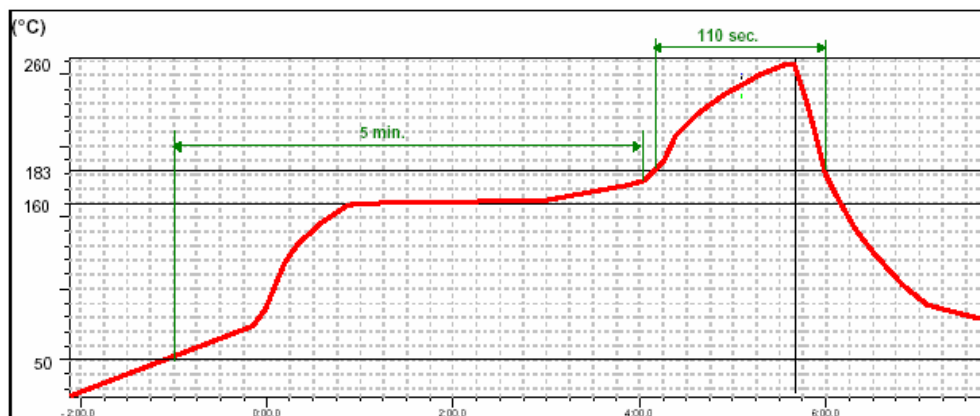


# "ORION™ 410" No-Clean Solder Paste

## III-11 Wetting test:

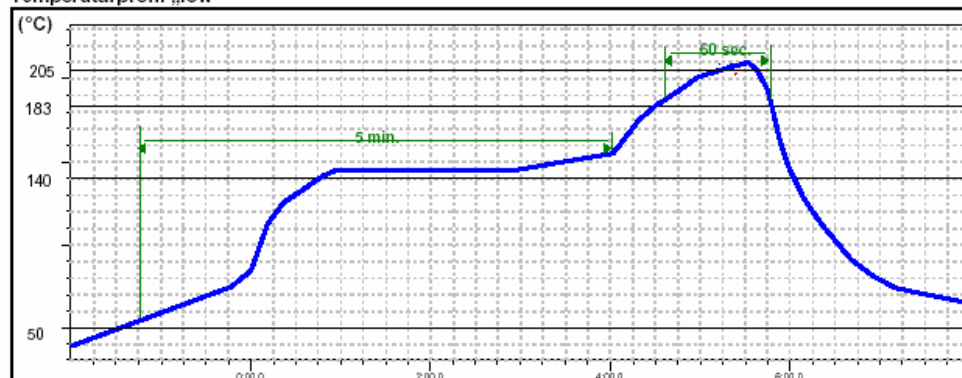
Test conditions	After 4 hrs 23°C 50% RH	After 4 hrs 23°C 83% RH
High reflow profile (See below)	Class 2*	Class 2*
Low reflow profile (See below)	Class 2*	Class 2*

\*Class 2= Wetting surface corresponds to printing area.



T<sub>Peak</sub>: = 260 °C  
 $\Delta T/\Delta t$  max = 4 K / sec.  
 T<sub>Vorwärm</sub> = 160 °C  
 t<sub>Peak</sub>: = 110 sec. (T > 183 °C)  
 t<sub>Vorwärm</sub> = 5 min. (T > 50°C bis Peakzone)

Temperaturprofil „low“



T<sub>Peak</sub>: = 205 °C  
 $\Delta T/\Delta t$  max = 4 K / sec.  
 T<sub>Vorwärm</sub> = 140 °C  
 t<sub>Peak</sub>: = 60 sec. (T > 183 °C)  
 t<sub>Vorwärm</sub> = 5 min. (T > 50°C bis Peakzone)



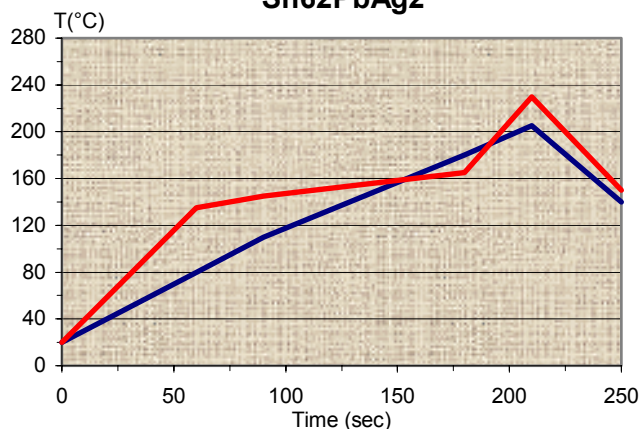
# "ORION™ 410" No-Clean Solder Paste

## III-12 Reflow:

### Reflow process capability:

- Infrared or convection (air and nitrogen)
- Vapour phase.
- Hot air.
- Hot plate.
- Laser
- Induction

Typical reflow profile  
Sn62PbAg2



Both reflow profile available, symmetric or asymmetric,  
with preheat plateau or constant increasing slope.

The solder paste offers a wide window during the reflow process.  
This enables the soldering of boards of varying thermal mass  
and also enables the use of lead free alloys.

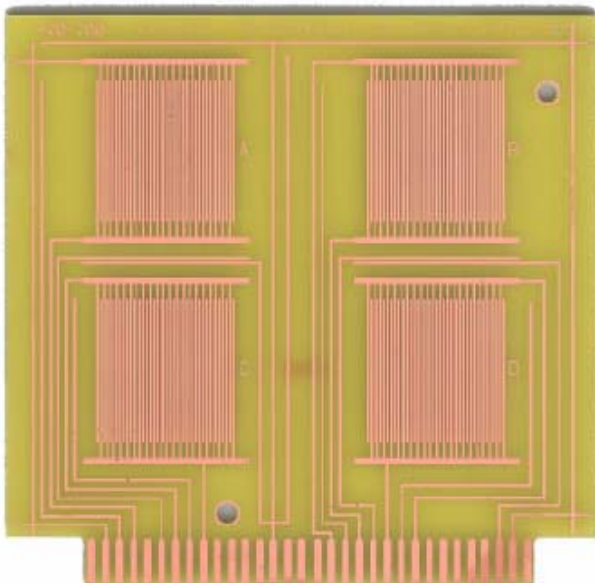


# "ORION™ 410" No-Clean Solder Paste

## IV) RELIABILITY TESTS:

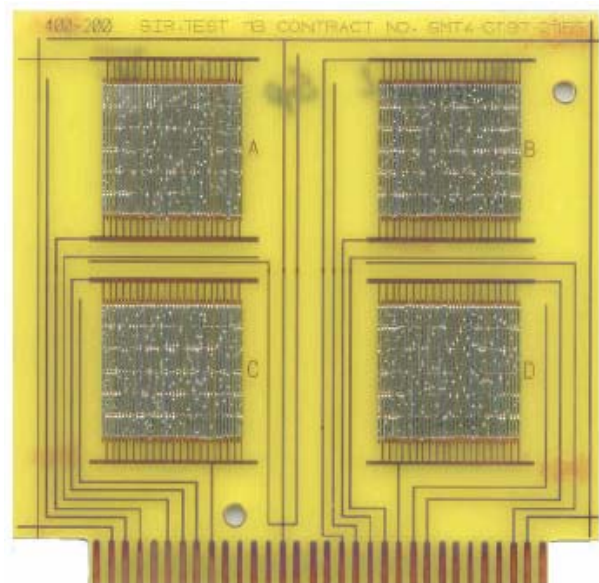
	Test	J-STD-004
IV-1	Copper mirror	Pass
IV-2	Silver chromate	Pass
IV-3	Fluoride Spot	Pass
IV-4	Copper Corrosion	Pass
IV-5	S.I.R. test	Pass

## SIEMENS TEST



Insulation measurement on virgin substrate:

$> 10^{10} \Omega$



Insulation measurement on soldered substrate:

$> 10^8 \Omega$

**PASS**

(See Siemens report in appendix III)

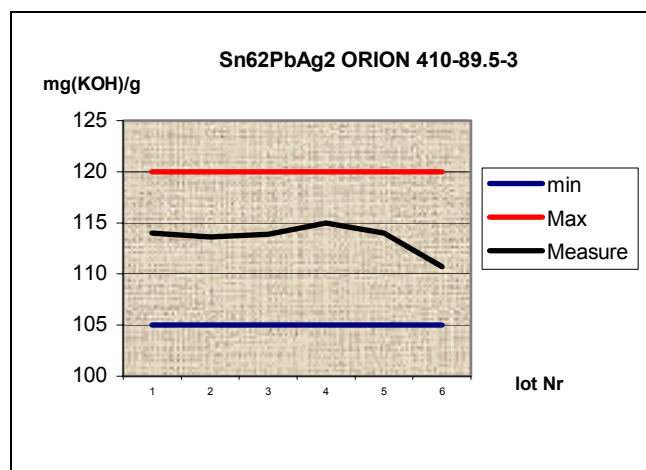


# "ORION™ 410" No-Clean Solder Paste

## IV-6) Acid Value

- METTLER TOLEDO DL50 TITRIMETER

105 mgKOH/g < AV < 120 mgKOH/g



## IV-7) Ionic Contamination:

Apparatus: Contaminometer CM11

Solution of test: 50/50 solution (Isopropyl alcohol / deionised water)  
Board Surface (1side) : 165 cm<sup>2</sup>

Laboratory temperature: 23°C

<b>Limit*</b>	→ <b>1.30</b> (µg NACL equivalent /cm <sup>2</sup> )
<b>Result</b>	→ <b>1.02</b> (µg NACL equivalent /cm <sup>2</sup> )

\*(MIL-P-28809, IPC-S-815 B, ANSI/J-STD-001A January 1995)

(See IFTEC report in appendix II)

# "ORION™ 410" No-Clean Solder Paste



## IV-8) BONO TEST:

This test was performed independently by the Laboratories at SCHNEIDER Group

The principle consists of evaluating the electrochemical corrosion that can be caused by the post-soldered residue of a flux or paste on a bare copper track

The test coupon with flux residue is subjected to a positive potential in specific conditions of temperature, humidity and duration:

2hrs 25°C/50%RH  
15 days 85°C/85%RH  
3hrs 25°C 50%RH.

The electrolytic cells are polarised under a dc voltage of 20V (+20V on the anode) throughout the duration of the test.

(See details in appendix IV)

Sn62PbAg2 ORION 410 – 89.5 - 3			
Board	Corrosion factor %	Path cutting	Conformity
Reference	0.25 ± 0.03	0	YES
Test board	7.6 ± 2.2	0	YES



# "ORION™ 410" No-Clean Solder Paste

## V) DELIVERY METHODS:

Proflow® 800g

Rheo pump cartridges

Syringes & Cartridges of 30g 100g EFD, SEMCO, IWASHITA

JARS 250g, 500g, 1Kg





# "ORION™ 410" No-Clean Solder Paste

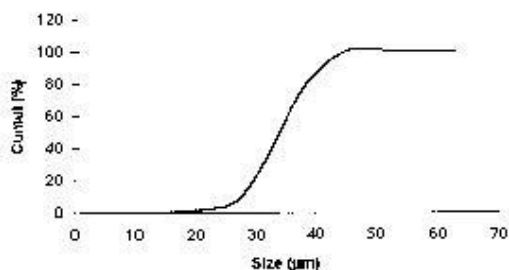
## APPENDIX I/1: "POWDER QUALITY CERTIFICATE"

### Quality certificate

### Solder powder size distribution shape

Alloy Designation :	Sn62 Pb36 Ag2	Powder Size :	Type 3
Manufacturer's Identification :		Quantity :	300 Kg
Manufacturer's Batch Number :	02 070	QC n° :	001 to 030
Date of Manufacture :	23/04/2002		
Date Inspection Completed :	29/04/2002	Overall Results :	<b>PASS</b> FAIL
Testing Methods Used :	Image Analysis		
Inspection Performed by :	N - Boucaud		

CUSTOMER MBO			
ANSI/J-STD-006	CUSTOMER REQUIREMENT	TEST RESULTS	PASS / FAIL
Max powder size > 50 µm 0 %		0%	PASS
Powder size			
25-45 µm 80 % Min		96.09 %	PASS
< 20 µm 10 % Max		1.43 %	PASS
Powder shape	Spherical	Spherical	PASS



Standard deviation : 4.99 µm
Mean Diameter : 33.92 µm
Maximum Diam : 43.77 µm

le 29/04/02  
ACCEPTÉ  
*[Signature]*

The Quality Manager  
*[Signature]*



# "ORION™ 410" No-Clean Solder Paste

## APPENDIX I/2: "POWDER QUALITY CERTIFICATE"

Quality certificate

Oxide content

Alloy Designation : Sn62 Pb36 Ag2 Powder Size: Type 3  
Manufacturer's Identification : Quantity : 300 Kg  
Manufacturer's Batch Number 02 070 QC n° 001 to 030  
Date of Manufacture 23/04/2002  
Date Inspection Completed : 29/04/2002 Overall Results : Pass Fail  
Testing Methods Used : Chemical  
Inspection Performed by : N - Boucaud

CUSTOMER MBO		
REQUIREMENT	TEST RESULTS	PASS / FAIL
Oxide content < 0.15%	0.070 %	PASS

The Quality Manager



# "ORION™ 410" No-Clean Solder Paste

## APPENDIX I/3: "POWDER QUALITY CERTIFICATE"

Quality certificate

Alloy chemical analysis

Alloy Designation: Sn62 Pb36 Ag2 Powder size: Type 3  
 Manufacturer's Identification: Quantity: 300 Kg  
 Manufacturer's Batch Number: 02 070 QC n°: 001 to 030  
 Date of Manufacture: 23/04/2002  
 Date Inspection Completed: 29/04/2002 Overall Results: **Pass** Fail  
 Testing Methods Used: Spectro  
 Inspection Performed by: N - Boucaud

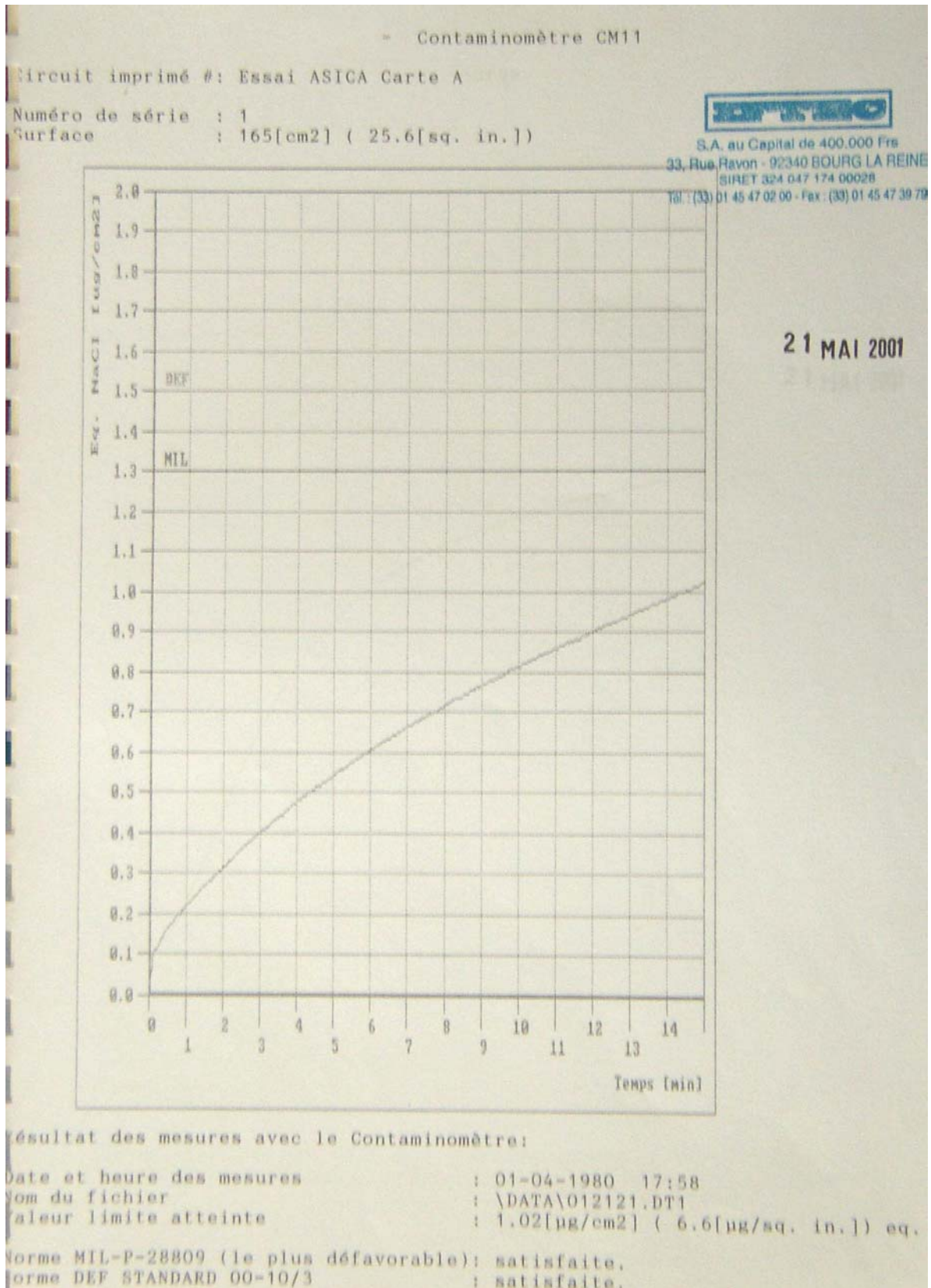
CUSTOMER: MBO				
Elements	Required Percentages		Percentages in Sample	Pass / Fail
	As an Alloy Element	As an Impurity Element		
Ag	1.8-2.2		2.02	PASS
Al		0.001 Max	< 0.001	PASS
As		0.01 Max	< 0.006	PASS
Bi		0.03 Max	< 0.005	PASS
Cd		0.002 Max	< 0.0005	PASS
Cu		0.01 Max	< 0.005	PASS
Fe		0.02 Max	< 0.005	PASS
Ni		0.005 Max	< 0.002	PASS
Pb	35.5-36.5		35.82	PASS
Sb		0.02 Max	< 0.005	PASS
Sn	61.5-62.5		62.12	PASS
Zn		0.002 Max	< 0.001	PASS

The Quality Manager



# "ORION™ 410" No-Clean Solder Paste

## APPENDIX II: "Ionic contamination"





# "ORION™ 410" No-Clean Solder Paste

## APPENDIX IV-1: "BONO TEST"

technical standard																							
<b>technical note</b>	<b>Circuit board</b>																						
	<b>Procedure for the characterisation of the corrosive power of solder fluxes and pastes using the Bono method</b>																						
French key words	crème à braser, flux, homologation																						
<b>Purpose</b>	This note describes the procedure for the characterisation of the corrosive power of solder fluxes and pastes using the BONO method, as well as the acceptance criteria.																						
<b>Experts to consult</b>	« Printed Circuit and Circuit Board » Centre.																						
<b>Modifications</b>	This note cancels and replaces the FI-67 564 and FI-67 565 sheets (Telemecanique Standard, SCO).																						
<b>Content</b>	<table border="0"> <tr><td>1. Objective.....</td><td>2</td></tr> <tr><td>2. Scope.....</td><td>2</td></tr> <tr><td>3. Principle.....</td><td>2</td></tr> <tr><td>4. Test circuit for fluxes.....</td><td>2</td></tr> <tr><td>5. Test circuit for the solder pastes.....</td><td>3</td></tr> <tr><td>6. Measuring bench.....</td><td>4</td></tr> <tr><td>7. Results.....</td><td>4</td></tr> <tr><td>    7.1. Electrical measurements.....</td><td>4</td></tr> <tr><td>    7.2. Microscopic observations and MEB analysis.....</td><td>4</td></tr> <tr><td>8. Conclusion.....</td><td>4</td></tr> <tr><td>9. References.....</td><td>4</td></tr> </table>	1. Objective.....	2	2. Scope.....	2	3. Principle.....	2	4. Test circuit for fluxes.....	2	5. Test circuit for the solder pastes.....	3	6. Measuring bench.....	4	7. Results.....	4	7.1. Electrical measurements.....	4	7.2. Microscopic observations and MEB analysis.....	4	8. Conclusion.....	4	9. References.....	4
1. Objective.....	2																						
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8. Conclusion.....	4																						
9. References.....	4																						
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author : X. Lambert	FT50 071(E) ind. AA																						
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# "ORION™ 410" No-Clean Solder Paste

## APPENDIX IV-2: "BONO TEST"

### 1. Objective

This note describes the procedure for the characterization of the corrosive power of solder fluxes and pastes using the BONO method, as well as the acceptance criteria.

It is intended for internal or external company laboratories, equipped with appropriate means for carrying out these tests.

### 2. Scope

This note applies to the solder fluxes and pastes used to manufacture electronic boards designed for integration in the Schneider products.

### 3. Principle

The principle consists of evaluating the electrochemical corrosion generated by the residue of a solder flux or paste after soft soldering on a naked copper conductor of printed circuit. The test coupon with this flux residue is subjected to a positive potential in specific conditions of temperature, humidity and duration.

This method is taken from the test procedure « Corrosive power of fluxes after use by the printed board method » (1).

### 4. Test circuit for fluxes

The test piece is shown in figure 1. It is made up of a 1.6 mm thick single side epoxy glass board on which six electrolytic cells are implemented containing a fine anode conductor passing between two wide cathode conductors.

Drawing n° W912211210 C001 :

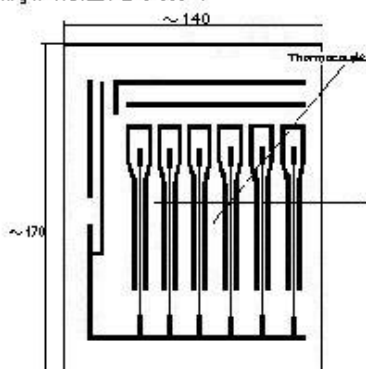


Figure 1. Test coupon (dimensions in mm)

The test pieces and particular the anode conductors used for our evaluations must be inspected and cleaned.

The dimensions of the electrolytic cell components are given in the following table :

	Length	Width	Thickness
Anode	80 mm	75 µm	9 ± 1 µm
Cathode	80 mm	3 mm	9 ± 1 µm

The inspections include:

- binocular observation of engraving quality,
- dimensional inspection of anode paths (width and thickness),
- measuring anode path resistance.

The board cleaning process consists of :

- a bath in an alkali desoxidant (produced by Alpha Metals ALPHA 921) for 5 seconds,
- rinsing in deionised water,
- rinsing in isopropanol 2,
- rinsing in deionised water,
- cleaning the boards in an acetone bath,
- rinsing in deionised water,
- drying under a hood on a sloping support (1).

instead of cleaning, an ionic contamination meter may be used (contamination < 0.5 µg Eq NaCl/cm²).

The flux to be evaluated must be applied on the board according to the assembly process with a thermal profile complying with the recommendations laid down in note FT50 061 or by the flux supplier.

The climatic cycle imposed on the test piece is shown in figure 2.

The electrolytic cells are polarised under a dc voltage of 250V (+ 250V on the anode) throughout the duration of the test.

Measurement of anode conductor resistance during the cycle gives us the corrosive power of the fluxes studied. This is expressed by the **corrosion factor**, noted Fc, and is equal to  $(Rd - Ro)/Ro$ , expressed as a % where :

- Ro : resistance on day zero
- Rd : resistance on day d

A flux is considered to satisfy the procedure if the corrosion factor at the end of the test is **less than 100%**, and if no corrosion product is present on the anode paths.



# "ORION™ 410" No-Clean Solder Paste

## APPENDIX IV-3: "BONO TEST"

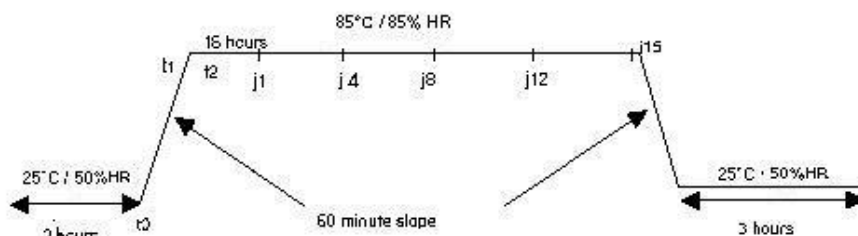


Figure 2 climatic cycle

### 5. Test circuit for the solder pastes

The test piece is shown in figure 3. It consists of a 1.6 mm thick single side epoxy glass board on which ten electrolytic cells are implemented (drawing n° WB1221121010004) containing a fine anode conductor passing between two wide cathode conductors

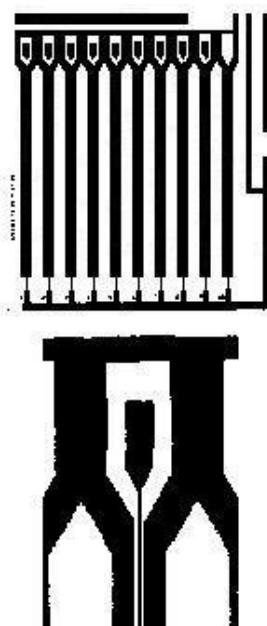


Figure 3 test piece and close up of an electrolytic cell

The dimensions of the electrolytic cell components are given in following table :

	Length	Width	Thickness
Anode	145 mm	75 µm	9 ± 1 µm
Cathode	145 mm	3 mm	9 ± 1 µm

The tests include :

- binocular observation of engraving quality,
- dimensional inspection of anode paths (width and thickness)
- measuring anode path resistance (value close to 6 Ω)

The board cleaning process consists of :

- a bath in an acid deoxidant (produced by Alpha Metals: ALPHA 92\*) for 5 seconds.
- rinsing in de-ionised water.
- rinsing in isopropanol 2.
- rinsing in de-ionised water.
- cleaning the boards in an acetone bath,
- rinsing in de-ionised water
- drying under a hood on a sloping support (1).

Instead of cleaning, an ionic contamination meter may be used (contamination < 0.5 µg Eq NaCl/cm²)

The solder paste to be evaluated is silk screen printed with metal foil (150 µm thick) made up of a series of openings (dimensions: L : 3 mm, . . . 2.7 mm) with a 4 mm pitch. The anode of the electrolytic cell acts as an axis of symmetry for positioning the metal foil.

The openings of the metal foil (placed opposite one other) must be centred with respect to the axis of symmetry to enable depositing on the electrolytic cell cathodes. Screen printing (squeegee movement) is performed at right angles to the electrolytic cells.

The deposit is formed on the cathode paths of the electrolytic cells and must be 15G = 20 µm thick.

The board is then inserted in an infrared reflow furnace with a thermal profile complying with the recommendations laid down in note FT50 D61 or by the paste supplier.

The board must be such that the flux residue completely covers the electrolytic cells and there are no soldering bridges between the anode and the cathode. The boards must not be retouched.

The climatic cycle imposed on the test piece is shown in figure 2.

The electrolytic cells are polarised under a dc voltage of 20V (+ 20V on the anode) throughout the duration of the test.

Procedure for the characterisation of the corrosive power of solder fluxes and pastes using the Bono method

FT50 071(E) ind. AA  
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Caution - Printed copy only for consultation : please check the release index before use.

# "ORION™ 410" No-Clean Solder Paste

## APPENDIX IV-4: "BONO TEST"

Measurement of anode conductor resistance during the cycle gives the corrosive power of the pastes studied. This is expressed by the corrosion factor, noted Fc, and is equal to  $(R_d - R_0)/R_0$ , expressed as a %, where:

- R<sub>0</sub> : resistance on day zero
- R<sub>d</sub> : resistance on day d

A soldering paste is considered to satisfy the procedure if the corrosion factor at the end of the test is **less than 8%**, and if no corrosion product is present on the anode paths.

### 6. Measuring bench

This bench may be made up of :

- a climatic chamber,
- a data acquisition station,
- two stabilised power supplies 40V/3A and 250V/100 mA,
- a picoammeter,
- a thermometer,
- a microcomputer automatically controlling all the devices.

The test pieces are connected to the measuring acquisition station as shown in figure 4 with silicon or Teflon sheathed cables (do not use P.V.C. cables).

The soldering wire used for cabling purposes must be an Sn/Pb 60/40 alloy or equivalent and have a flux without cleaning.

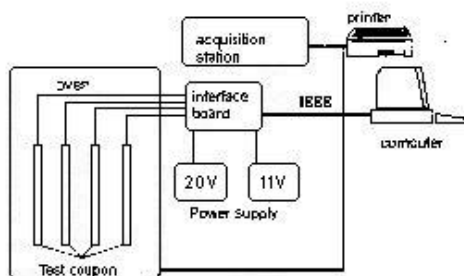


Figure 4 : Measuring bench

Measurements taken for each board:

- Measuring anode wire resistance using the « 4 wires » method. During this measurement the 250V or 20V power supply (electrical field = 127 kV/m) is disconnected (1)
- Measuring corrosion current: the corrosion current of the test piece is calculated using the measurement of the voltage drop at the terminals of a resistance of :
  - 10kΩ (10W) for fluxes,
  - 22kΩ (10W) for solder pastes

## 7. Results

### 7.1. Electrical measurements

- plot the developing curves of the corrosion factor and corrosion current during the cycle
- note the day when anode paths were cut
- note the paths failing to satisfy the selection criterion.

### 7.2. Microscopic observations and MEB analysis

Board analysis must highlight:

- path cutting,
- corrosion residue and type of residue,
- the presence of dendrites and of "Conductive Anodic Filament" (CAF) (2).

## 8. Conclusion

The only solder fluxes and pastes accepted are those with a low residue ratio which satisfy the corrosion factor criterion and leave no signs of corrosion on the test boards.

## 9. References

- (1) Essais Interlaboratoires NF "Corrosive power of fluxes after use by the printed board method" ; Institut de Soudure A 49-050/HP 3000 ; December 1990.
- (2) X. Lambert & al; « Study of the corrosive power of solder pastes » , 3 rd Int. Conf. on Solder Fluxes and Pastes ; CNET France Telecom ; Lannion ; France ; 1993.
- (3) R.J. Klein Wassink ; Soldering in electronics ; Electrochemical Publications ; 1989.