the product:

A lead-free wave solder alloy that delivers high yield, fast throughput and economy.

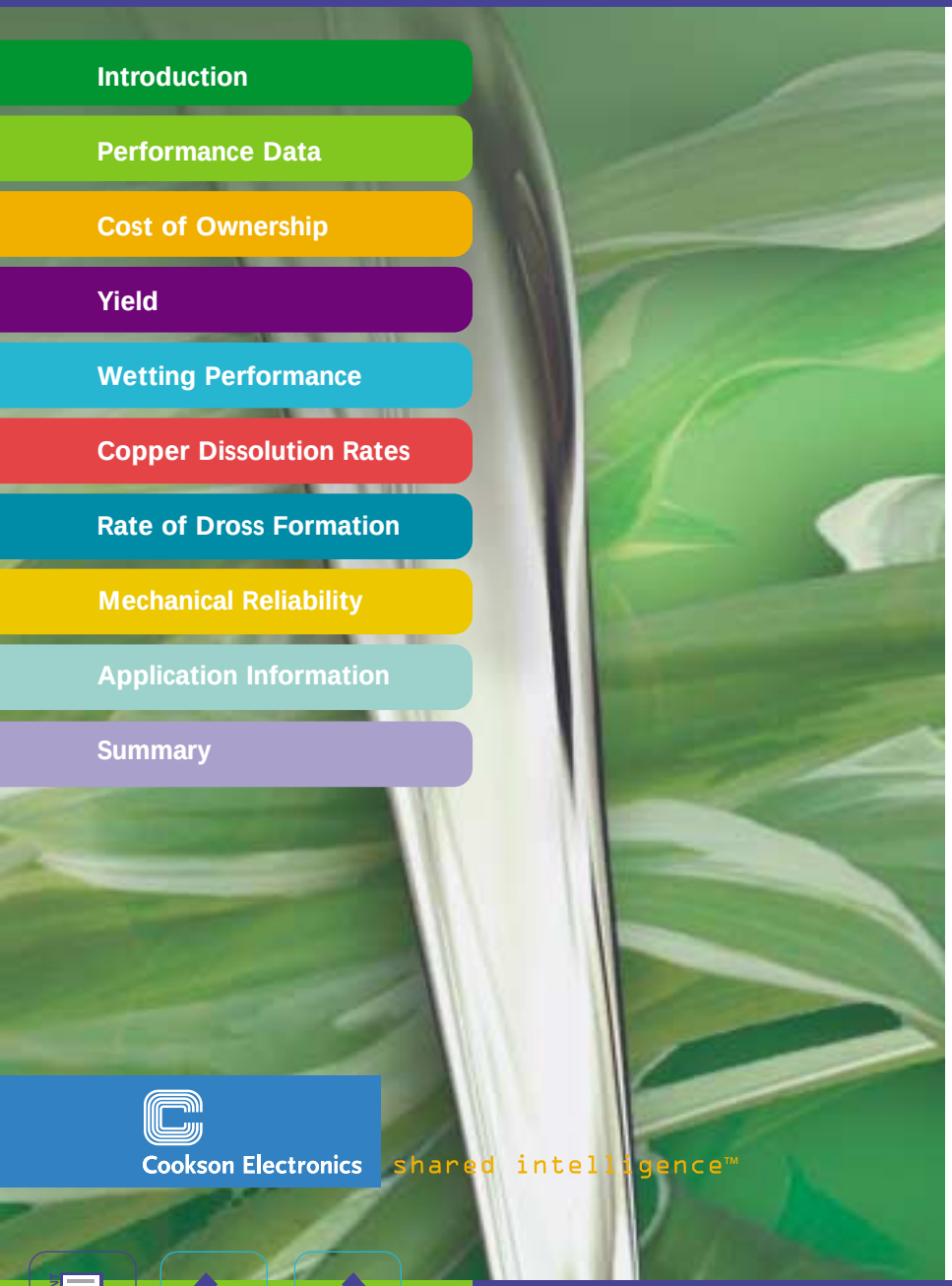
Vaculoy SACX0307

product guide

alpha

Cookson Electronics shared intelligence™

SM809



Cookson Electronics shared intelligence™

Welcome to the Vaculoy SACX0307 Interactive Product Guide

Simply click on the navigation buttons to quickly locate specific product information.

There are links to other documents and to Cookson Electronics' website, where you can obtain additional information. To use this feature, you must launch your internet browser.

alpha

Introduction

BACK TO MAIN MENU

Introduction

First we considered what you're up against. You have to remain price-competitive while meeting new lead-free regulations. You have chosen to use the wave solder process for your PCB assembly because it offers you high yields and fast throughput, and is the most economical process for your PCB design. You will need this in your lead-free process. To make that happen, you need a wave solder alloy that balances value and performance.

Cookson Electronics Assembly Materials has recognized these requirements and has developed **ALPHA Vaculoy SACX0307**, the new Lead-Free wave solder alloy and new compatible cored solder wire that will meet these needs.

During development of this product, the leading competitive product and Industry Standard Vaculoy SAC305 were benchmarked. In some applications, Industry Standard Vaculoy SAC305 outperforms ALPHA Vaculoy SACX0307. However, Lead-Free ALPHA Vaculoy SACX0307 outperforms all Sn/Cu-based alloys in more demanding applications. ALPHA SACX0307 is protected by a patent: US4929423.

ALPHA Vaculoy SACX0307 delivers:

- High Yields
- Lowest Total Cost of Ownership
- Fast Wetting
- Low Dross Generation
- High Joint Mechanical Reliability
- Low Process Maintenance

Cookson Electronics

alpha

Performance Summary

Process Benefit	ALPHA Vaculoy SACX0307	Performance Capability	Customer Benefits
Wave Solder Process	Yield	Comparable yield to Industry Standard Vaculoy SAC305 and much superior to leading competitor's Sn/Cu-based alloy	Lower rework and warranty costs
	Wetting speed	Wetting speed of 0.75 sec compared to 0.65 sec for Industry Standard Vaculoy SAC305 and 1.00 sec for leading competitor's Sn/Cu-based product	High yield and throughput rates achievable
	Contact time, pot temperature and conveyor speed	Contact time: 2.3 - 3.5 sec; pot temperature: 255º - 265º Celsius (491º - 509º F); conveyor speed: 1.0 - 1.5 m/min (3.3 - 5 ft/min)	Wide wave solder process window
Process Maintenance	Dross generation	Low levels of dross generation	Lower solder consumption
	Copper dissolution rate	Comparable to higher cost, Industry Standard SAC305; process monitoring and equilibrium point for copper will be equivalent	Process monitoring costs are equivalent
Joint Reliability	Surface mount shear strength	Surface mount components shear strength comparable to higher cost, Industry Standard Vaculoy SAC305	Equivalent reliability at lower cost
	Through hole pull strength	Equivalent to Industry Standard Vaculoy SAC305 for pull strength on through hole components	Equivalent reliability at lower cost
	Thermal cycling	Equivalent to Industry Standard Vaculoy SAC305 and 63/37 over 400 cycles (-40º to +125ºC), tests ongoing	Indication of acceptable product life

Cookson Electronics

Performance Summary

- Introducing Vaculoy SACX0307
- Performance Data

BACK TO MAIN MENU

Comparison

ALPHA Vaculoy SACX0307			Units	Baseline SAC305	Vaculoy SACX0307	Competitor A
Process Attribute	Defect Rate		%	-	+5%	+60%
	Wetting Speed	Time F Max	Sec mN/mm	0.60 0.26	0.75 0.21	1.00 0.10
	Copper Erosion (3 sec contact)		Micron/sec*	11.0	10.7	11.7
	Drossing Rate		Index	100**	39	43
	Mechanical Reliability		Rank	1	1	3
	Relative Cost		Index	1	0.65-0.75	0.65-0.75

* 1 micron/sec = 25 mils/sec

** Generic alloy - No Vaculoy conditioning or dross-reducing agent

Delivers High Performance and Value Versus Other Wave Solder Alloys

- Demonstrates superior performance to other low-cost solutions for Lead-Free Wave Soldering.
- Offers economy and high yields.

Competitor A : Leading competitor's Sn/Cu-based alloy

Cookson Electronics

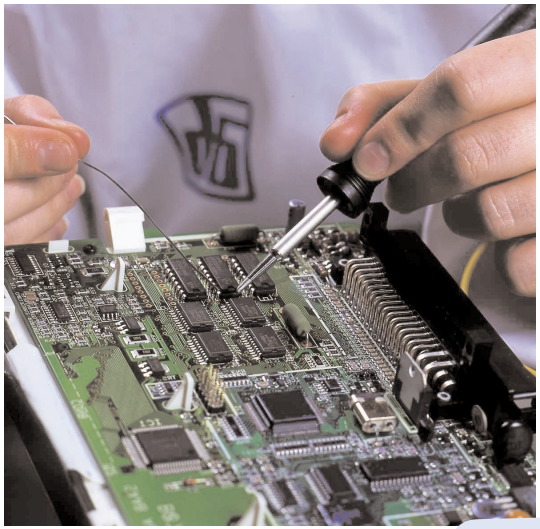
Cost of Ownership

- Example: Total Cost of Ownership

BACK TO MAIN MENU

Example: Total Cost of Ownership

Low complexity assembly, 75 components and 425 solder joints	Units	ALPHA Vaculoy SACX0307	Competitor A
Assembly yield	%	96.3%	94.4%
DPMO *	ppm	75	117
No. solder joints per board	-	425	425
Mass of solder per board	grams	18	18
No. of boards per year	-	1,000,000	1,000,000
Cost per board	$US	$20	$20
Number of defects per year	-	31875	49725
Cost to rework defect **	$US	$1.025	$1.025
Total rework cost	$US	$32,672	$50,968
Total solder used	kg	18000	18000
Cost savings	$US	**$18,296**	
Savings per kg of solder	$US/kg	**$1.02**	



* DPMO: Defects per million opportunities. Competitor A's assumed to be 55% greater than ALPHA SACX0307 based on benchmark studies. Baseline of 75 assumed for ALPHA SACX0307

** Based on actual customer data, includes ICT costs - calculations available on request.

Lower Cost of Ownership than Competitor A

- Higher yields deliver cost savings.
- Significant savings per kg of solder consumed.

Alpha

Cookson Electronics

Product Testing Design

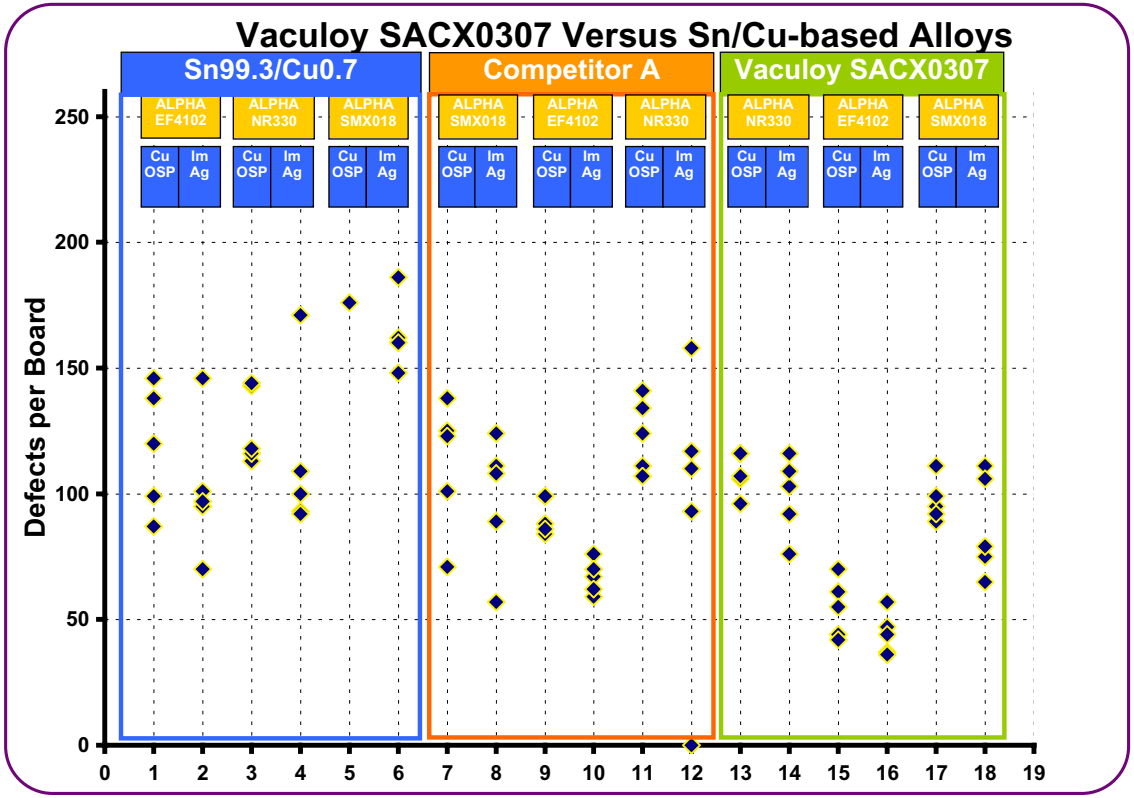
Run	Alloy	Flux	Board Finish
Run 1	Sn99.3/CuO.7	ALPHA EF-4102	Cu OSP
Run 2	Sn99.3/CuO.7	ALPHA EF-4102	Im Ag
Run 3	Sn99.3/CuO.7	ALPHA NR-330	Cu OSP
Run 4	Sn99.3/CuO.7	ALPHA NR-330	Im Ag
Run 5	Sn99.3/CuO.7	ALPHA SMX018	Cu OSP
Run 6	Sn99.3/CuO.7	ALPHA SMX018	Im Ag
Run 7	Competitor A	ALPHA SMX018	Cu OSP
Run 8	Competitor A	ALPHA SMX018	Im Ag
Run 9	Competitor A	ALPHA EF-4102	Cu OSP
Run 10	Competitor A	ALPHA EF-4102	Im Ag
Run 11	Competitor A	ALPHA NR-330	Cu OSP
Run 12	Competitor A	ALPHA NR-330	Im Ag
Run 13	ALPHA Vaculoy SACX0307	ALPHA NR-330	Cu OSP
Run 14	ALPHA Vaculoy SACX0307	ALPHA NR-330	Im Ag
Run 15	ALPHA Vaculoy SACX0307	ALPHA EF-4102	Cu OSP
Run 16	ALPHA Vaculoy SACX0307	ALPHA EF-4102	Im Ag
Run 17	ALPHA Vaculoy SACX0307	ALPHA SMX018	Cu OSP
Run 18	ALPHA Vaculoy SACX0307	ALPHA SMX018	Im Ag
Run 19	SAC305	ALPHA EF-4102	Cu OSP
Run 20	SAC305	ALPHA EF-4102	Im Ag

Competitor A: Leading competitor's Sn/Cu-based alloy

The experiment was designed to be a run of 18 (3 alloys x 3 fluxes x 2 board finishes). The SAC305 alloy was added for one flux and two board finishes resulting in a run of 20 experiments. Five test boards were used for each run.

Cookson Electronics

Test Results by Flux Technology



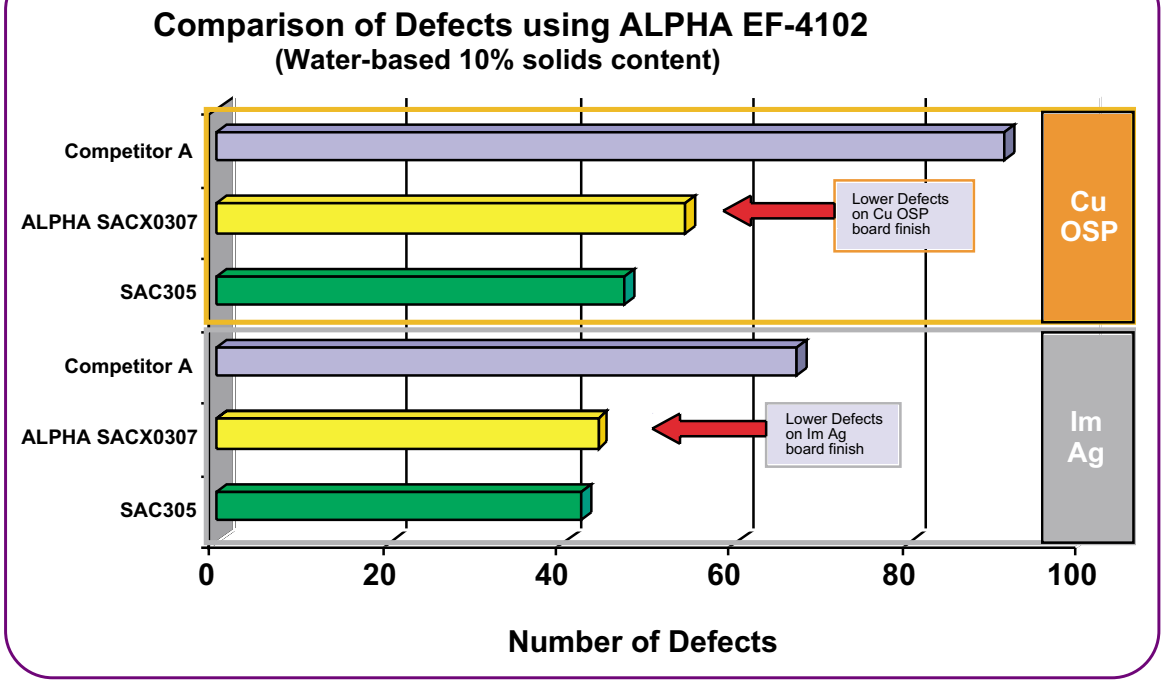
Competitor A: Leading competitor's Sn/Cu-based alloy

Fewer Defects Across All Flux Technologies

- Delivers better drainage resulting in significantly fewer defects.

Cookson Electronics

Yield Alloy Benchmarking



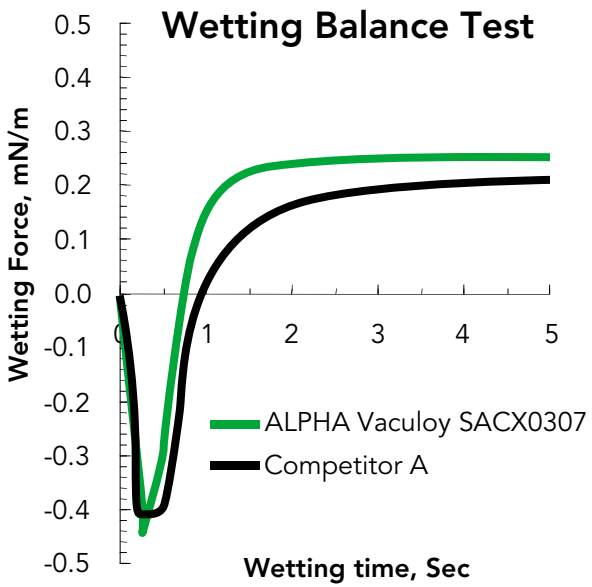
Competitor A: Leading competitor's Sn/Cu-based alloy

Comparable Yield to Higher-Cost Lead-Free Alloys

- Defect rates were comparable to Industry Standard SAC305.

Cookson Electronics

Test Results Summary



The wetting balance or Meniscograph is used to determine the wetting performance of a given solder alloy. The variables of temperature, flux and test coupon are kept constant.

Faster wetting speed and higher wetting force indicate that the solder alloy has a greater ability to wet the solderable part.

For example, the ALPHA SACX0307 data line crosses the force axis at around 0.75 sec after start of test. This is superior performance to Competitor A, as that data line crosses the axis at 1.00 sec.

Competitor A: Leading competitor's Sn/Cu-based alloy

Faster Wetting Speed Gives Better Soldering Yields

- Wetting speed results shows that ALPHA Vaculoy SACX0307 has good wetting speed (0.6 - 0.9 sec), even on fluxes with lower solids content.

Cookson Electronics

Wetting Performance
- Test Results Summary
- Test Results Flux Technology

BACK TO MAIN MENU

Wetting Performance Results by Flux Technology

Flux Type			BASELINE SAC305	Vaculoy SACX0307		Competitor A	
Flux Base	Solids Content	Flux Name	T° Seconds	T° Seconds	% increase	T° Seconds	% increase
Water	3.50%	Competitor B	0.60	0.90	50%	1.25	108%
Water	3.50%	ALPHA EF-2202	0.60	0.75	25%	1.00	67%
Water	6.20%	ALPHA EF-3215	0.50	0.75	50%	1.00	100%
Alcohol	2.50%	ALPHA RF-800	0.50	0.75	50%	0.90	80%
Water	10%	ALPHA EF-4102	0.50	0.60	20%	0.75	50%

As a general rule a wetting time of greater than one second is considered unacceptable in the wave solder process.

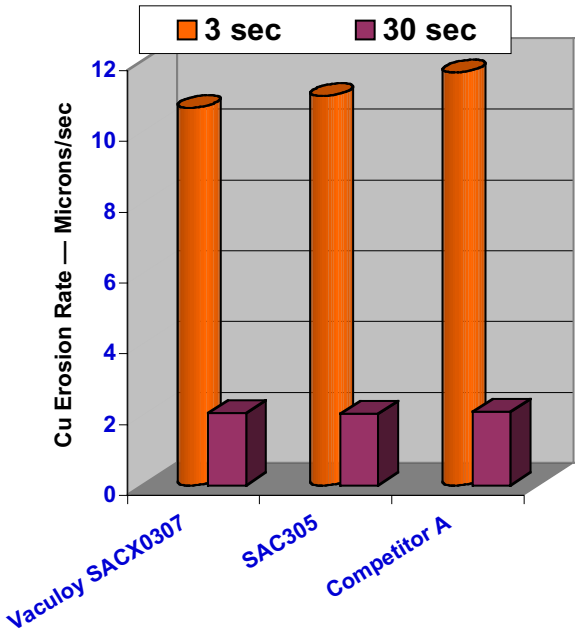
Competitor A: Leading competitor's Sn/Cu-based alloy

Wide Flux Technology Process Window

- The variation of the wetting speed from low to medium solid fluxes is less for ALPHA Vaculoy SACX0307 (0.3 sec) than for Competitor A (0.5 sec).
- This gives greater flexibility for flux selection with lower solids contents.

Cookson Electronics

Test Results Summary



The rate at which an alloy dissolves copper is important in maintaining good wave solder process control.

If the copper level increases, it can have the effect of increasing the liquidus temperature of the alloy. If this is not controlled, there will be a detrimental effect on the soldering process.

For Sn/Cu alloys, each 0.1% increase in Cu level will increase the liquidus by 2.5° Celsius

For SAC alloys, each 0.1% increase in Cu will increase the liquidus by 1.9° Celsius.

The test for copper dissolution involves dipping a copper wire specimen into the solder alloy for a specified time and then measuring the change in diameter. Flux, temperature and time are fixed.

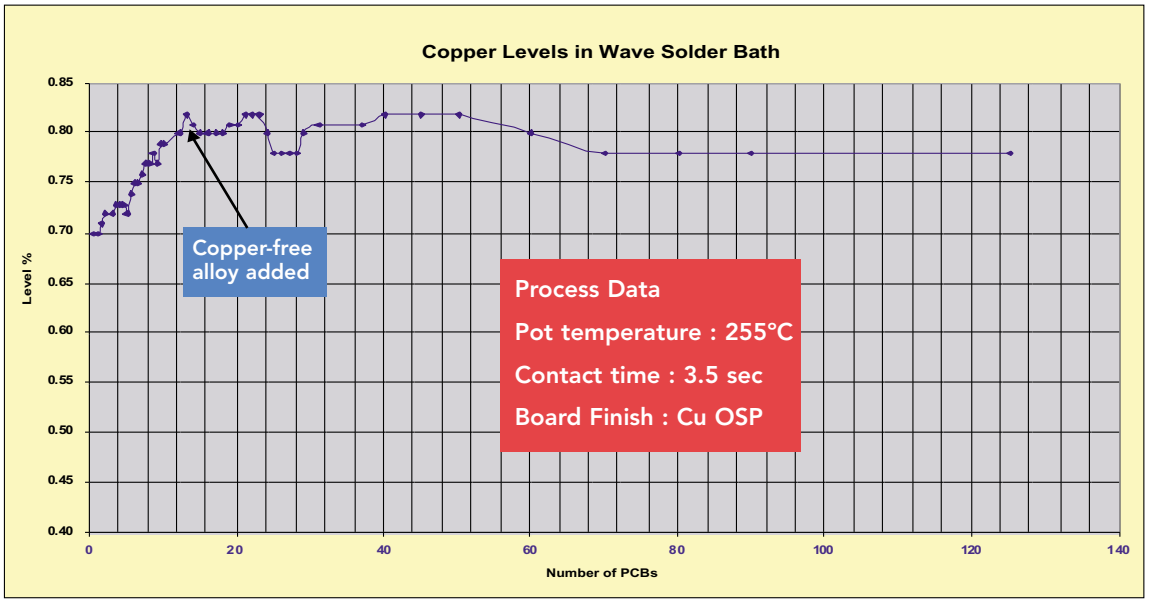
Competitor A: Leading competitor's Sn/Cu-based alloy

Copper Dissolution Rates are Lower for ALPHA Vaculoy SACX0307

- Lower dissolution rate of copper will make copper levels in the bath easier to control.

Cookson Electronics

Management of Copper Levels



Management of levels of copper in the bath are important to maintain good yields.

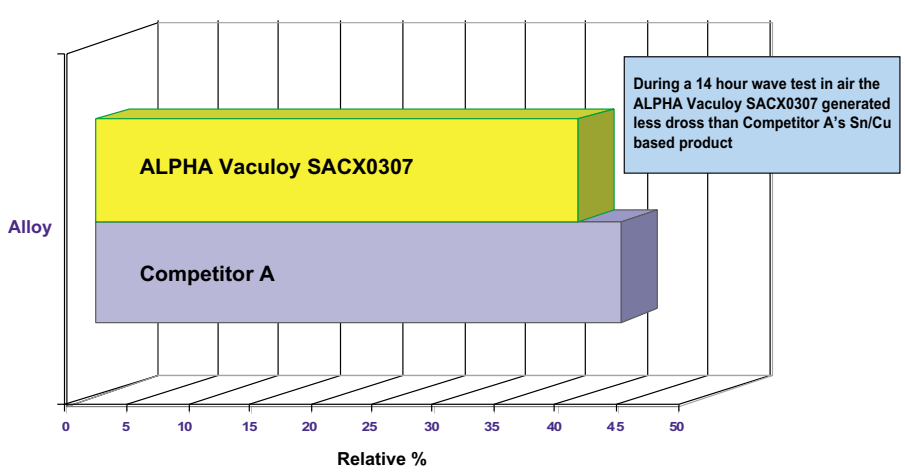
To maintain the levels of copper, it is suggested that the bath be analyzed at intervals of every 8000 boards and that the levels be controlled by adding SACX0300 alloy as a make-up.

Regular measurement and analysis during the early stages of processing will help to gauge the equilibrium point and guide the frequency on monitoring.

alpha

Cookson Electronics

Rate of Dross Formation



Dross formation is directly related to the Total Cost of Ownership of the material. The lower the dross formation, the lower the cost of soldering each joint.

The dross formation characteristics of alloys are determined by 3 factors -

Alloy purity: Some **impurities** increase dross formation

Alloy conditioning: Chemical treatments can reduce dross formation

Alloy additives: Change the type of dross produced (dry powder as opposed to emulsified "wet" dross)

ALPHA Vaculoy SACX0307 has been engineered for optimal performance.

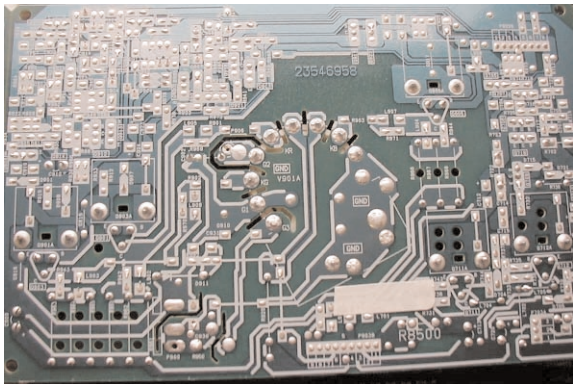
Competitor A: Leading competitor's Sn/Cu-based alloy

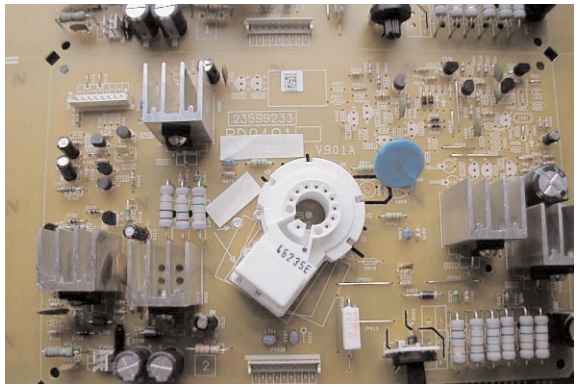
Lower Rates of Oxide (i.e., dross) Generation

- Reduced solder consumption, frequency of pot maintenance and chance of oxide contamination of the solder joint.
- Careful removal of oxide is required to maximize cost savings.

Cookson Electronics

Through Hole Test





Production boards from a TV producer were soldered using three alloys : ALPHA Vaculoy SAC305, ALPHA Vaculoy SACX0307 and ALPHA Vaculoy 63/37.

Pull tests were conducted on three types of components and the max force to failure was recorded.

Tensile testing equipment was used to conduct the tests.

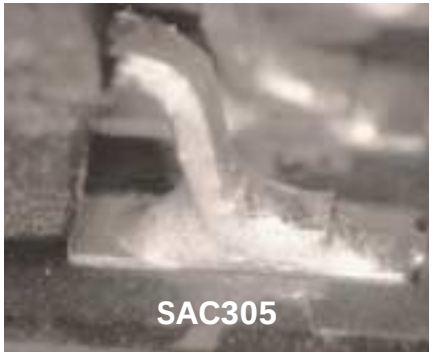
Tin Technology Ltd. undertook the testing.

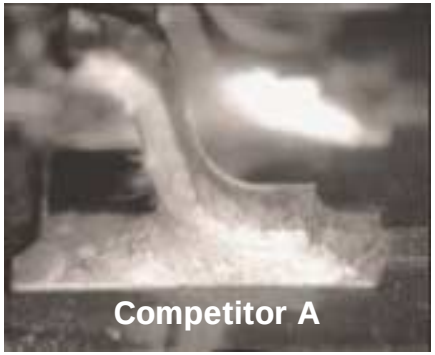
Component		Alloy		
		Baseline SAC305	SACX0307	63/37
		Force (Newtons)		
Large Resistors	Mean	66	72	79
	Std Dev	11	11	14
Heat Sink Pins	Mean	219	202	192
	Std Dev	22	19	23

Mechanical Joint Strength Equivalent to Industry Standard Vaculoy SAC305

Cookson Electronics

Joint Formation





All joints soldered using same process conditions and flux.

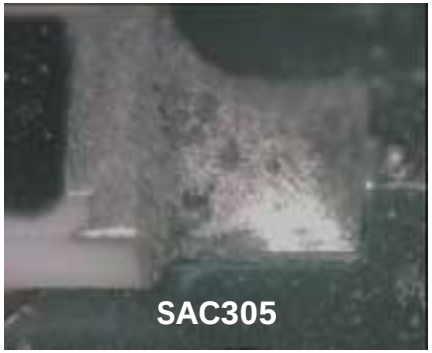
Full Fillets Ensure Mechanically Sound Joints

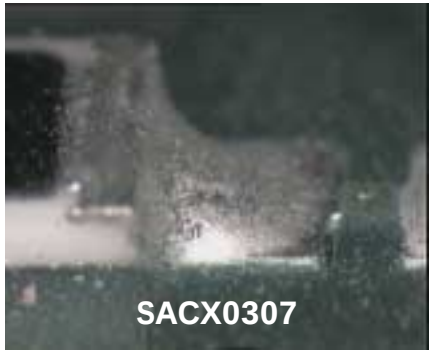
- Equal to or better than Industry Standard SAC305.
- Superior joint formation to Competitor A product.
  - Good toe and heel wetting.
  - Good wetting angles.
  - Smooth regular grain structure.

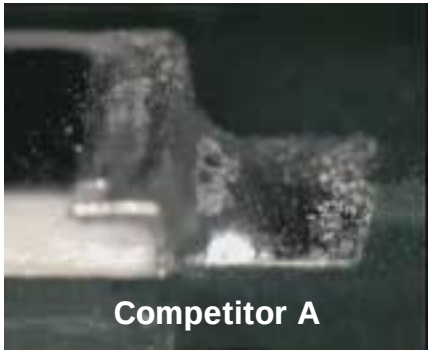
Competitor A: Leading competitor's Sn/Cu-based alloy

Cookson Electronics

Surface Mount Shear Strength







Preferred result : High shear force and low Std Dev.

Chip Shear				
		Baseline SAC305	SACX0307	Competitor A
Component		Force (Newtons)		
1208 Chip Resistor	Mean	135	140	115
	Std Dev	25	12	20

Mechanically Strong Surface Mount Joints

- Shear testing of 1206 chip resistors generated excellent results for ALPHA Vaculoy SACX0307.

Competitor A: Leading competitor's Sn/Cu-based alloy

Cookson Electronics

Thermal Cycling

	Number of Failures				
No of Cycle	Baseline SAC305	Vaculoy SACX0307	Competitor A	63/67	Sn99.3/Cu0.7
400	Zero	Zero	Zero	Zero	Zero
800	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

Test Conditions

- Cycle parameters: -40º to +125º Celsius, 40 minute cycle, 10 minute soak at upper and lower temperature.
  - – Number of cycles: 400 to date – 1000+ cycles planned
  - – Boards: CPS test board, Cu OSP pad finish.
  - – Alloys: ALPHA Vaculoy SACX0307, Industry Standard SAC305, Competitor A, Sn99.3/Cu0.7 and Sn63/Pb37.
  - – Number of circuits per board: 24 circuits each with 50 surface mount resistors, 1206 and 0804 in each circuit, wired in series.
  - – Failure measured as resistance increases across circuit at % above threshold value (TBD after initial variances are measured).

Competitor A: Leading competitor's Sn/Cu-based alloy

Thermal Mechanical Reliability Comparable to 63/37 and Industry Standard SAC305

Cookson Electronics

Recommended Process Parameters

Wave Configuration	Process Parameter	Suggested Process Settings
Single Wave	Pot Temperature	255º-265º Celsius (491º-509º F)
	Conveyor Speed	1.0-1.5m/min (3.3-5 ft/min)
	Contact Time	2.3-2.8 seconds
	Wave Height	1/2 to 2/3 of board thickness
	Dross Removal	Once per 8-hour run time
	Copper Check	Every 8,000 boards until 40,000
Dual Wave	Pot Temperature	255º-265º Celsius (491º-509º F)
	Conveyor Speed	1.0-1.5m/min (3.3-5 ft/min)
	Contact Time	3.0-3.5 seconds
	Wave Height	1/2 to 2/3 of board thickness
	Dross Removal	Once per 8-hour run time
	Copper Check	Every 8,000 boards until 40,000

Cookson Electronics

alpha

Changing a Solder Bath from Sn/Pb to Lead-Free

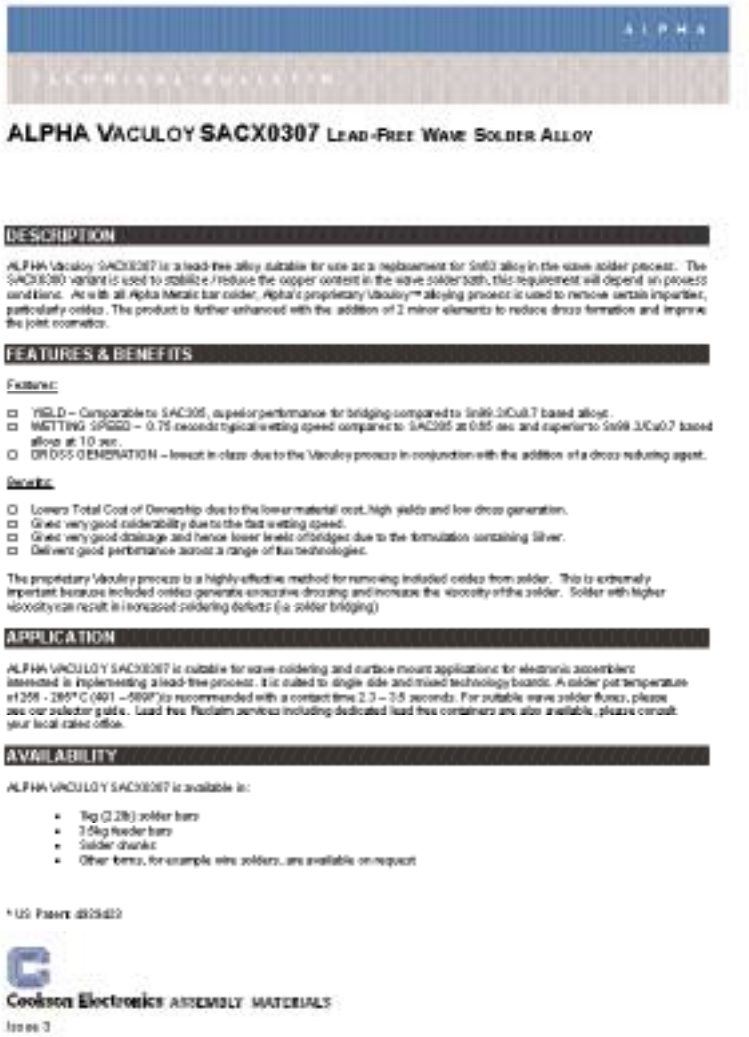
1	Remove the pumps, wave guides and flow ducts from the solder bath.
2	Drain the Sn/Pb material from the solder bath.
3	Clean the solder bath, removing all visible deposits of Sn/Pb alloy. Suitable respiratory protective equipment, safety glasses/visor and gloves must be worn.
4	Clean the pumps, wave guides and flow ducts – using the same procedure as above.
5	Load the wave pot with pure tin (available in chunks and bars).
6	Re-assemble the pumps, wave guides and flow ducts.
7	Take pot temperature to 260º Celsius and switch on the chip and main waves and allow the metal to circulate for 30 minutes. This will remove any remaining lead contamination from the pot.
8	Drain the tin wash from the wave pot.
9	Load the Lead-Free solder in the same way as above and take a sample of the pot to establish a baseline composition.

Cookson Electronics

alpha

Technical Bulletin

For more information, Click on arrow.



ALPHA VACULOY SACX0307 LEAD-FREE WAVE SOLDER ALLOY

DESCRIPTION

FEATURES & BENEFITS

APPLICATION

AVAILABILITY

Cookson Electronics ASSEMBLY MATERIALS

Cookson Electronics

alpha

MSDS

For more information, Click on arrow.

Conforms to 91/155/EEC - 2001/58/EC

SAFETY DATA SHEET

Alpha Vaculoy Solder Bar SACX0307

1. Identification of the substance/preparation and of the company/undertaking

Product name : **Alpha Vaculoy Solder Bar SACX0307**

Code : **SACX**

Head Office : Cookson Electronics
Forsyth Road
Sheerwater
Woking
Surrey
GU21 5RZ
Tel: +44(0)1483 758400
Fax: +44(0)1483 728837

Manufacturer : Naarden Manufacturing Site
Energiestraat 21
1411 AR Naarden
The Netherlands
Tel: +31 (35) 695 5411
Fax: +31 (35) 694 8451

2. Composition/information on ingredients

Substance/Preparation : Preparation

Chemical name*	CAS no.	%	EC Number	Classification
Europe tin	7440-31-5	80-100	231-141-8	

See Section 16 for the full text of the R Phrases declared above

* Occupational Exposure Limit(s), if available, are listed in Section 8

3. Hazards identification

The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.
The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.
The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.
The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Skin contact : Irritation of the product in case of skin contact: Not available. Sensitization of the product: Not available.

Aggravating conditions : Repeated or prolonged exposure is not known to aggravate medical condition.

4. First-aid measures

First-Aid measures

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Obtain medical attention.

Ingestion : Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Obtain medical attention.

Eye Contact : Check for and remove any contact lenses. In case of contact, immediately flush eyes with a copious amount of water for at least 15 minutes. Obtain medical attention.

5. Fire-fighting measures

Extinguishing Media

Suitable : Not applicable.

Special fire-fighting procedures : Fire fighters should wear self-contained positive pressure breathing apparatus (SCBA) and full turnout gear.

Cookson Electronics

Evaluation Guide

1	For loading of alloy into wave machine, follow instructions “Changing a solder bath from Sn/Pb to Lead-Free,” included in this manual.
2	If changing flux, please refer to Evaluation Guide included in the Flux Product Manual.
3	Make sure that the solder pot and wave are free from dross.
4	Check that pot temperatures is set at correct level.
5	Ensure that the conveyor height is sufficient to give clearance above wave former on any through hole leads.
6	Set the contact time using a wave profile device or glass plate. Adjust the conveyor speed and wave height accordingly.
7	Check fingers and pallet for cleanliness.
8	FLUX: Check for uniform spray on the board and measure flux loading. Compare with recommended levels.
9	FLUX: Measure the top side preheat with flux applied to the bottom side board. Adjust temperature setting on the machine to achieve recommended temperature.

Cookson Electronics

alpha

Material Technical Data

Material Property	Units	Baseline SAC305	SACX0307	Competitor A
Solidus	Celsius	217	217	228
Liquidus	Celsius	219	228	228
Stress at MAX Load (N/mm^2)	Mean Std Dev	32 2	30 1	28 3
Elongation at Failure %	Mean Std Dev	25 4	22 9	23 8
Hardness	HV	15.2	14.1	11.3
Density	g/cc	7.39	7.34	7.33
Specific Heat Capacity	J/kg C	0.22	0.17	0.25
Thermal Expansion Coefficient	(30º-100ºC)/Cx10^{-5} (100º-150ºC)/Cx10^{-5}	1.91 2.64	1.79 2.30	1.88 2.56

Competitor A: Leading competitor's Sn/Cu-based alloy

Cookson Electronics

alpha

ALPHA Flux Product Line: A solution for every need.

ALPHA EF-Series of environmentally friendly fluxes are designed to keep your process fully productive. Whether you specialize in consumer products, telecommunications, automotive or high product-mix production, you'll find ALPHA EF-Series fluxes will meet your needs for higher yield and throughput. Select the EF-Series product that is right for your needs.

	Water-Based				Alcohol-Based
Features	**EF-2202**	**EF-3001**	**EF-3215**	**EF-4102**	**EF-9301**
Appearance	Clear	Milky	Milky	Amber	Pale Yellow
Resin/Rosin Content	0%	<5%	<5%	<10%	<6%
VOC Content	<2%	<1%	<2%	<10%	<93%
Lead-Free Compatible	Y	Y	Y	Y	Y
Bellcore Compliant	Y	Y	N	Y	Y
Wetting/Hole Fill	2	3	1	1	1
Solderballing	1	2	2	1	1
Pin Testability	1	3	2	-	1
Cleanability	2	3	3	3	3
Tack	-	2	2	2	2
Conformal Coating	1	1	1	-	-
Joint Cosmetics	1	2	2	1	1 (Full Dulling)*
Selective Soldering	1	3	2	-	-

Note: 1=Superior, 2=Excellent, 3=Good, Y=Yes, N=No
*In product category

Cookson Electronics

Selector Guide

ALPHA EF-Series Water-Based Fluxes

Series	Product	Application
ALPHA EF-2000	ALPHA EF-2202	EMS, Telecom, Computer
ALPHA EF-3000	ALPHA EF-3001, ALPHA EF-3215	Consumer Products, Automotive
ALPHA EF-4000	ALPHA EF-4102	Consumer Products

ALPHA EF-Series Alcohol-Based Fluxes

Series	Product	Application
ALPHA EF-9000	ALPHA EF-9301	Consumer Products

CEAM's Leading ALPHA Fluxes

Series	Product	Application
ALPHA RF-800	RF-800 Universal, No-Clean	Universal
ALPHA SLS-65	SLS-65C Rosin-Free, No-Clean	EMS, Telecom
Water-Soluble	856, 373	Universal
ALPHA NR-330	NR-330 Universal, No-Clean VOC-Free	EMS, Telecom

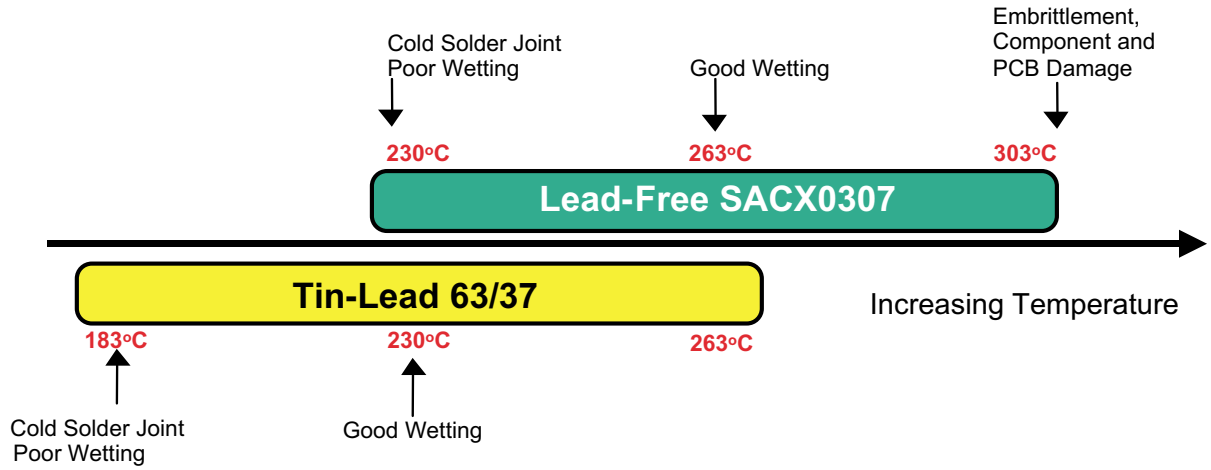
Application Information
- Recommended Process Parameters
- Changing a Solder
- Technical Bulletin
- Material Safety Data Sheet
- Evaluation Guide
- Material Technical Sheet
- ALPHA Flux Product Line
- **Rework**
- Troubleshooting Guide
- Glossary

BACK TO MAIN MENU

Cookson Electronics

alpha

Elevated Rework Temperature Effects



Lead-Free Rework Considerations:

- Heat transfer to the component and board is less controlled than any other process due to manual nature of repair work.
- Soldering iron tips will corrode quicker using high-tin lead-free alloys.

Use CEAM's new ALPHA Vaculoy SACX0307 cored wire and target the optimum rework temperatures to deliver reliable joints.

Cookson Electronics

alpha

Recommendations for Successful Lead-Free Joint

Impact of Higher Soldering Temperatures and Longer Contact Times:

- Increased chances of
  - – Printed circuit board and/or component damage
  - – Generation of more intermetallics and hence brittle joint
  - – Premature flux fuming, yielding less flux on the joint, during the rework process

Manual rework training for lead-free will be required in the transition to lead-free.

Cookson Electronics

alpha

Solder Iron Requirements

Solder Iron Settings

- Temperature of piece that is to be soldered (not the iron) should be around 250ºC (482ºF) and the solder iron tip should be a temperature of about 370ºC (698ºF). This should give an acceptable heat transfer time using the correct tip size.
- Aim for a contact time of 2-3 seconds. Overheating a joint damages the board and may lead to board reliability issues over the lifetime of the product.
- Use a soldering iron bit that is suitable (see figure above): a bit that is too small may prevent the formation of a joint or slow down the rework operation.
- Do not overheat as this can cause an increase in the depth of the intermetallic layer resulting in a weaker joint.

Planning the processing methods for the manual rework operation is critical to delivering a reliable lead-free process.

Cookson Electronics

alpha

Barriers to a Successful Lead-Free Joint

Solutions to Lead-Free Rework Issues:

- Minimize heat transfer to the board and component – more heat = more potential damage.
- Use lead-free alloy with fastest wetting speed and lowest melting point, typically rework alloy should be the same as the wave solder alloy.
- Ensure that there is enough flux on the joint to make a bond in the shortest time possible.
- Use an iron with suitable controller that minimizes its temperature variance.

Cookson Electronic Assembly Materials provides solutions for your lead-free processing issues.

Cookson Electronics

alpha

Troubleshooting Guide

For more information, Click on the arrow

Cookson Electronics

alpha

Cookson Electronics

Glossary

Solidus: The temperature at which the transition from solid to liquid starts.

Liquidus: The temperature above which, in equilibrium, all the alloy should be in the liquid phase. In the temperatures between solidus and liquidus, there will be crystals of solid in equilibrium with liquid alloy.

Hardness: A measure of a material's resistance to deformation. The Vickers test applies a load to a pyramid-shaped indentor pressed into the alloy for a few seconds. The size of the indentation is measured and converted to a number to describe the hardness – the higher the number, the harder the alloy. Solders generally have values between 10 and 20 at room temperature.

Density: Weight divided by volume, usually expressed as grams per cubic centimeter, or as kgs per cubic meter. The alloy must be solid (no cavities or voids) for the figure to be accurate.

Specific heat capacity: A measure of the energy required to increase the temperature of one gram or one kilogram of solid material by one degree Celsius. An equal amount of heat is given out by the material when it cools by one degree Celsius.

Stress at maximum load: Derived from the stress strain curve measured during a tensile test. During the test the strain (elongation) continues at the predefined constant speed, and the instantaneous loads required to do this are measured by a load cell. The stress quoted is the maximum load recorded divided by the original cross sectional area of the test piece.

Elongation at failure: The increase in length of the test piece at the moment of failure in a tensile test divided by the original length and expressed as a percentage. Higher values indicate greater ductility, but the scatter of results can be quite high, particularly with cast structures.

Thermal expansion coefficient: The fractional change in length of solid material caused by a temperature rise of one degree Celsius. Usually this is expressed as parts per million. This value changes slightly according to the temperature range in which it is measured.

alpha

Summary

BACK TO MAIN MENU

Summary

A New Lead-Free Solder Alloy
High Yield, Low Maintenance and Reliability

Delivers better yield than all Sn/Cu-based products

- Total cost of ownership lowest in class
- Wetting speed faster than all Sn/Cu-based products

Delivers low levels of process maintenance

- Low levels of dross generation
- Low levels of Copper dissolution

Delivers high joint reliability

- Mechanical pull and shear tests demonstrate joint strengths equivalent to tin lead and SAC305
- Thermal cycling tests to date indicate comparable reliability

alpha

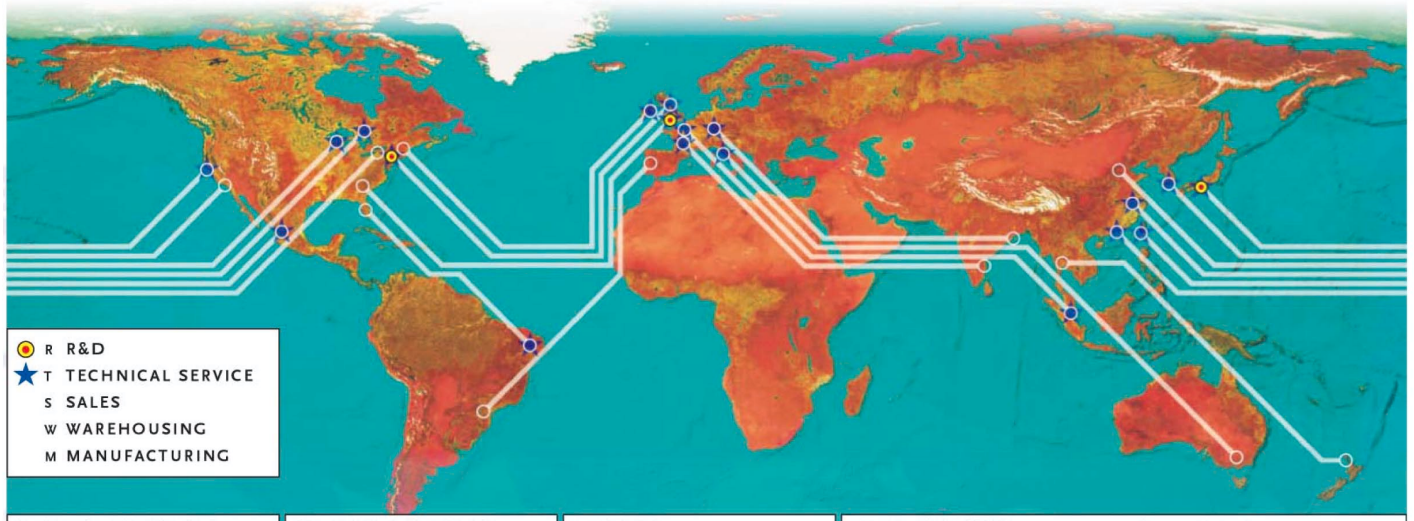
Cookson Electronics

Summary

BACK TO MAIN MENU

Worldwide Capacity

Cookson Electronics helps make you more efficient and profitable with enabling technology, products and service support available worldwide.



NORTH AMERICA	
California, USA	TSM
Florida, USA	M
Georgia, USA	SWM
Illinois, USA	TSWM
New Jersey, USA	RTSWM
New York, USA	M
Ontario, Canada	TS
Guadalajara, Mexico	TSWM

SOUTH AMERICA	
Capital Federal, Argentina	SW
Manaus, Brazil	WM
Sao Paulo, Brazil	TSWM

EUROPE	
Woking, England	TS
Ashford, England	WM
Turnhout, Belgium	SWM
Paris, France	TSW
Lagenfeld, Germany	TS
Budapest, Hungary	TSWM
Dublin, Ireland	TSWM
Milan, Italy	TSW
Naarden, Netherlands	TSWM
East Kilbride, Scotland	TSWM
Madrid, Spain	S

ASIA PACIFIC	
Hong Kong, China	TSWM
Beijing, China	TSWM
Chengdu, China	S
Nanjing, China	S
Shanghai, China	TSW
Shenzhen, China	TSWM
Xiamen, China	SW
Chennai, India	SWM
Hiratsuka, Japan	RTSWM
Sihung City, Korea	TSWM
Penang, Malaysia	TSW
Muntinlupa, Philippines	S
Singapore, Singapore	TSWM
Lu-Chu Hsiang, Taiwan	TSWM
Kaohsiung, Taiwan	SW
Bangkok, Thailand	SW
Melbourne, Australia	S
Auckland, New Zealand	SW

For additional information, visit Cookson Electronics Assembly Materials at **www.alphametals.com**

Cookson Electronics

alpha

ALPHA VACULOY SACX0307 LEAD-FREE WAVE SOLDER ALLOY

DESCRIPTION

ALPHA Vaculoy SACX0307 is a lead-free alloy suitable for use as a replacement for Sn63 alloy in the wave solder process. The SACX0300 variant is used to stabilize / reduce the copper content in the wave solder bath, this requirement will depend on process conditions. As with all Alpha Metals bar solder, Alpha's proprietary Vaculoy™ alloying process is used to remove certain impurities, particularly oxides. The product is further enhanced with the addition of 2 minor elements to reduce dross formation and improve the joint cosmetics.

FEATURES & BENEFITS

Features:

- YIELD – Comparable to SAC305, superior performance for bridging compared to Sn99.3/Cu0.7 based alloys.
- WETTING SPEED – 0.75 seconds typical wetting speed compares to SAC305 at 0.65 sec and superior to Sn99.3/Cu0.7 based alloys at 1.0 sec.
- DROSS GENERATION – lowest in class due to the Vaculoy process in conjunction with the addition of a dross reducing agent.

Benefits:

- Lowers Total Cost of Ownership due to the lower material cost, high yields and low dross generation.
- Gives very good solderability due to the fast wetting speed.
- Gives very good drainage and hence lower levels of bridges due to the formulation containing Silver.
- Delivers good performance across a range of flux technologies.

The proprietary Vaculoy process is a highly effective method for removing included oxides from solder. This is extremely important because included oxides generate excessive drossing and increase the viscosity of the solder. Solder with higher viscosity can result in increased soldering defects (i.e solder bridging)

APPLICATION

ALPHA VACULOY SACX0307 is suitable for wave soldering and surface mount applications for electronic assemblers interested in implementing a lead-free process. It is suited to single side and mixed technology boards. A solder pot temperature of 255 - 265° C (491 – 509F) is recommended with a contact time 2.3 – 3.5 seconds. For suitable wave solder fluxes, please see our selector guide. Lead free Reclaim services including dedicated lead free containers are also available, please consult your local sales office.

AVAILABILITY

ALPHA VACULOY SACX0307 is available in:

- 1kg (2.2lb) solder bars
- 3.5kg feeder bars
- Solder chunks
- Other forms, for example wire solders, are available on request

*** US Patent 4929423**

Cookson Electronics ASSEMBLY MATERIALS

HEALTH & SAFETY

Please refer to MSDS for advice on proper handling and safety instructions.

TECHNICAL SPECIFICATION

US Patent 4929423

Material Property	Units	Vaculoy SACX
Solidus	Celsius	**217**
Liquidus	Celsius	**228**
Hardness	HV	**14.1**
Density	g/cc	**7.34**
Specific Heat Capacity	J/kg C	**0.17**
Stress at MAX Load (N/mm^2)	Mean	**29.5**
	SD	**0.64**
Elongation at failure (%)	Mean	**21.8**
	SD	**8.8**
Thermal Expansion Coefficient	(30 - 100C)/C x 10^{-5}	**1.79**
	(100 - 150C)/C x 10^{-5}	**2.30**

RECOMMENDED PROCESS SETTINGS

Wave Configuration	Process Parameter	Suggested Process Settings
Single Wave	Pot temperature	255 - 265 Celsius (491 - 509 F)
	Conveyor speed	1.0 - 1.5 m/min (3.3 - 5 ft/min)
	Contact time	2.3 - 2.8 seconds
	Wave Height	1/2 to 2/3 of board thickness
	Dross removal	Once per 8 hour run time
	Copper Check	Every 8,000 boards until 40,000
Dual Wave	Pot temperature	255 - 265 Celsius (491 - 509 F)
	Conveyor speed	1.0 - 1.5 m/min (3.3 - 5 ft/min)
	Contact time	3.0 - 3.5 seconds
	Wave Height	1/2 to 2/3 of board thickness
	Dross removal	Once per 8 hour run time
	Copper Check	Every 8,000 boards until 40,000

Issue 2

Return to Product Manual

Cookson Electronics ASSEMBLY MATERIALS

MANAGEMENT OF COPPER LEVELS IN THE SOLDER BATH

Management of the copper level in the wave solder bath is critical to ensure low defects in the soldering process. There is a tendency for the copper levels of the SACX0307 materials to increase due to the leaching effect of the solder wave on the board and components. This effect is at its most severe when using an OSP Copper finish on the PCB.
Studies have shown a typical leaching rate of **0.01% Cu per 1000 boards**. Each process is unique this is an indication only of the leaching rate (based on actual data).
It is recommended that the copper is controlled at between 0.7% and max 1.0% for SACX0307 alloy. If the copper levels are higher than 1.0% then this will increase the liquidous temperature which in turn may mean that the solder bath temperature has to be increased to maintain the process yields.
The copper levels in the bath can be controlled by means of adding **SACX0300** to the wave solder pot. It may be the case that equilibrium can be attained by continuing with SACX0300 additions as the only means of solder top up, however each process is unique and we would recommend regular analysis of the solder bath so that good control of copper can be maintained.
This analysis service is available from **Cookson Electronics Assembly Materials**, contact your local office for details.

RECOMMENDED ACTION LEVELS FOR WAVE SOLDER IMPURITES

Please find below a list of recommended action levels for wave solder bath impurities. For information of specific action plans to bring your solder bath back to an acceptable condition please contact your local sales office.

Aluminium*:	As little as 0.0005% may increase dross rate without affecting joint formation.
Arsenic:	Above 0.03% can cause dewetting.
Bismuth:	Bismuth should not be a contaminant in solder baths unless bismuth is present as a solderable coating on the board or on component terminations. If this is the case then some dulling of the solder joints may occur. Bismuth at low levels should not be a problem provided that lead contamination is not also present. If both elements are found then fillet lifting phenomena are more likely
Cadmium*:	At levels of 0.002% joint formation will be noticeably affected. At 0.005% there will be a high incidence of bridging and icicling, together with a diminution in joint strength.
Copper:	Copper levels will increase in many cases due to pick up from board surfaces. This causes the liquidous of the bath material to increase slightly. Generally systems are tolerant to levels up to 1.0% Cu, but in some cases it may be necessary to increase bath temperatures by a few degrees, or to correct the bath composition at an earlier stage.
Gold:	At levels of 0.1% and quite often less, the solder becomes sluggish and dull joints are formed.
Iron:	0.02% of iron can make joint formation gritty.
Lead:	The lead level that might be a problem is likely to depend on the board type, and criticality of application. It may also depend on the legislation in markets into which the products are sold. 0.35% should not be a problem on single sided boards.
Silver:	Silver is often an alloying element in lead-free solders. The presence of silver at levels over 0.1% can be tolerated in solder bath alloys originally devoid of silver but may be an indication that there is some other problem with the bath.
Zinc*:	The presence of zinc can cause dulling and create bridging and icicling. 0.005% can also cause lack of adhesion and grittiness.

Note: *The effects of Al, Cd and Zn are cumulative. If more than one element is present the following lower maxima are suggested: 0.0005%, 0.002% and 0.001%

Headquarters
Cookson Electronics Assembly Materials
600 Route 440
Jersey City
NJ 07304, U.S.A.
Tel: +1 (201) 434 6778
Fax: +1 (201) 434 7508
www.alphametals.com

Regional Sales Offices:

Belgium	Tel:	+32 (0) 14 44 50 00	Japan:	Tel:	+81 463 53 3333
Brazil	Tel:	+55 11 4353 2500	Korea:	Tel:	+82 31 499 1451
France:	Tel:	+33 (0) 2 41 49 00 11	Mexico:	Tel:	+52 3 818 9500
Germany:	Tel:	+49 (0) 203 55540	Netherlands:	Tel:	+31 (0) 35 695 5411
Hong Kong:	Tel:	+852 3190 3100	Singapore:	Tel:	+65 6861 1977
Hungary	Tel:	+36 (0) 24 460 72 0	Taiwan:	Tel:	+886 (3) 322 2721
India:	Tel:	+91 44 625 2666	UK:	Tel:	+44 (0) 1483 793100
Ireland:	Tel:	+353 (0) 1 842 1172	USA - Elgin:	Tel:	+1 (847) 697 1735
Italy:	Tel:	+39 (0)2 38 33 11			

Issue 2

Return to Product Manual

SAFETY DATA SHEET

Cookson Electronics ASSEMBLY MATERIALS

Alpha Vaculoy Solder Bar SACX0307

1. Identification of the substance/preparation and of the company/undertaking

Product name : **Alpha Vaculoy Solder Bar SACX0307**

Code : **SACX**

Head Office :
Cookson Electronics
Forsyth Road
Sheerwater
Woking
Surrey
GU21 5RZ
Tel: +44(0)1483 758400
Fax: +44(0)1483 728837

Manufacturer :
Naarden Manufacturing Site
Energiestraat 21
1411 AR Naarden
The Netherlands
Tel: +31 (35) 695 5411
Fax: +31 (35) 694 8451

2. Composition/information on ingredients

Substance/Preparation : Preparation

Chemical name*	CAS no.	%	EC Number	Classification
Europe				
tin	7440-31-5	80-100	231-141-8	
See Section 16 for the full text of the R Phrases declared above				

*** Occupational Exposure Limit(s), if available, are listed in Section 8**

3. Hazards identification

The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.

The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.
The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.
The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Skin contact : Irritation of the product in case of skin contact: Not available. Sensitization of the product: Not available.

Aggravating conditions : Repeated or prolonged exposure is not known to aggravate medical condition.

4. First-aid measures

First-Aid measures

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Obtain medical attention.

Ingestion : Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Obtain medical attention.

Eye Contact : Check for and remove any contact lenses. In case of contact, immediately flush eyes with a copious amount of water for at least 15 minutes. Obtain medical attention.

5. Fire-fighting measures

Extinguishing Media

Suitable : Not applicable.

Special fire-fighting procedures : Fire fighters should wear self-contained positive pressure breathing apparatus (SCBA) and full turnout gear.

Return to Product Manual

6. Accidental release measures

Personal Precautions : Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Environmental precautions and cleanup methods : Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Note: See section 8 for personal protective equipment and section 13 for waste disposal.

7. Handling and storage

Handling : No specific safety phrase has been found which is applicable for this product.

Storage : Keep container tightly closed. Keep container in a cool, well-ventilated area.

Packaging materials

Recommended use : Use original container.

Danish Fire Class : Not applicable.

8. Exposure controls/personal protection

Engineering measures : Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Hygiene measures : Wash hands after handling compounds and before eating, smoking, using lavatory, and at the end of day.

Ingredient Name	Occupational Exposure Limits
Europe	
tin	**ACGIH TLV (United States, 2001). Skin** STEL: 0.2 mg/m^3 15 minute(s).
Sweden	
Denmark	
Norway	
France	
Netherlands	
tin	**Nationale MAC-lijst (Netherlands, 2001). Notes: Tentative** TGG 8 uur: 2 mg/m^3 8 hour(s).
Germany	
Finland	
tin	**Työterveyslaitos (Finland, 2002).** TWA: 2 mg/m^3 8 hour(s).
United Kingdom (UK)	
tin	**EH40-OES (United Kingdom (UK), 2002).** TWA: 2 mg/m^3 8 hour(s). STEL: 4 mg/m^3 15 minute(s).
Austria	
tin	**BMWA_MAK (Austria, 2001).** STEL: 4 mg/m^3 4 times per shift, 15 minute(s). TWA: 2 mg/m^3 8 hour(s).
Switzerland	
Belgium	
tin	**Lijst Grenswaarden (Belgium, 1998). Skin** VL: 2 mg/m^3 8 hour(s).
Spain	
tin	**INSHT (Spain, 2001).** TWA: 2 mg/m^3 8 hour(s).

Personal protective equipment

Skin and body : Lab coat.

Eyes : Safety glasses.

Return to Product Manual

9. Physical and chemical properties

Physical state : Solid.

Colour : Silvery.

Odour : Not available.

pH : Not applicable.

Melting point : 231.8°C (449.2°F) based on data for: tin.

Flash point : Not applicable.

Explosive properties : Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Oxidizing properties : Not available.

Density : The only known value is 7.31 g/cm^3 (tin).

Solubility : Insoluble in cold water, hot water.

10. Stability and reactivity

Stability : The product is stable.

Hazardous decomposition products :

11. Toxicological information

Local effects

Chronic toxicity : Repeated or prolonged exposure is not known to aggravate medical condition.

12. Ecological information

13. Disposal considerations

Methods of disposal ; Waste of residues ; Contaminated packaging : Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Waste Classification : Not applicable.

European Waste Catalogue (EWC) : Not available.

Hazardous Waste : To present knowledge of the supplier, this product is not regarded as hazardous waste as defined by EU Directive 91/689/EC.

14. Transport information

International transport regulations

Regulatory Information	UN number	Proper shipping name	Class	Packing group	Label	Additional Information
ADR/RID Class	Not regulated.	-	-			-
IMDG Class	Not regulated.	-	-			-
IATA-DGR Class	Not regulated.	-	-			-

15. Regulatory information

EU Regulations

Risk Phrases : This product is not classified according to the EU regulations.

Product Use : Classification and labelling have been performed according to EU directives 67/548/EEC, 1999/45/EC, including amendments and the intended use.
- Industrial applications.

Additional Warning Phrases : Safety data sheet available for professional user on request.

EC Statistical Classification (Tariff Code) : 32089091

Return to Product Manual

National regulations

Denmark

Additional Warning Phrases	:	Not applicable.
Denmark – Cancer Risks	:	Not available.
Denmark – Restrictions on Use	:	Not available.
Statutory Order 571 on Aerosols	:	Not applicable.

Netherlands

K-Klasse	:	K5
CPR	:	Not regulated.
SHHR	:	0ZZ

Germany

Ordinance on Combustible Liquids	:	Class: Omitted
Technical instruction on air quality control	:	Class III 3.1.4: 0.7%
Hazard class for water	:	2

16. Other information

Full text of R-Phrases with no. appearing in Section 2 - Europe	:	
Text of classifications appearing in Section 2 - Europe	:	

HISTORY

Date of printing	:	**04/12/2003.**
Date of issue	:	**04/12/2003.**
Date of previous issue	:	**No Previous Validation.**
Version	:	**1**
Prepared by	:	**Simon Hosken** **Environmental, Health and Safety Manager**

Notice to Reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Return to Product Manual