

# ALPHA<sup>®</sup> VACULOY<sup>®</sup> SAC300,305,350,380,387,400,405

## High Silver Alloy for Wave and Selective Soldering

### DESCRIPTION

ALPHA SAC305, SAC387 and SAC405 and their replenishment alloys ALPHA SAC300, SAC350, SAC380 and SAC400 are lead-free alloys suitable for use as a replacement for Sn63Pb37 alloy. The replenishment alloys are sometimes used to stabilize and reduce the copper content in the wave solder bath, although, this requirement will depend on process conditions. As with all Alpha's bar solder, the proprietary Vaculoy alloying process is used to remove certain impurities, particularly oxides.

READ ENTIRE TECHNICAL DATA SHEET BEFORE USING THIS PRODUCT

### FEATURES AND BENEFITS

#### Features

- Yield – Best in class yield, outperforms all Sn/Cu based materials
- Wetting speed – fast wetting, in back to back tests 0.65s compared to 1.00s, for Sn/Cu based materials
- Dross generation – Low dross generation delivered by our proprietary Vaculoy manufacturing process

#### Benefits

- Excellent solderability due to fast wetting speed
- Very good drainage, has lower levels of bridging compared to Sn/Cu alloys
- Delivers excellent performance across a wide 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 GUIDELINES**

ALPHA SAC305, SAC387 and SAC405 are suitable for lead free wave soldering and selective soldering. A solder pot temperature of 255 to 265 °C (491 to 509 °F) is recommended for wave soldering application. If used for selective soldering, a solder pot temperature of 280 to 320 °C (536 to 608 °F) is recommended. N<sub>2</sub> environment (<1000ppm O<sub>2</sub>) can be considered for further oxidation reduction.

For suitable solder fluxes, contact your local sales representative. Lead free Reclaim services including dedicated lead free containers are also available. Please consult your local sales office.

**TECHNICAL DATA**

0.10% of Lead (Pb) complies with all requirements of RoHS Directive 2015/863/EU. Alloy specification for maximum Lead (Pb) Content = 0.07%. ALPHA SAC alloy is also available in ALPHA Ultra Low Lead (ULL) version which contains a maximum of 0.05% Pb. All alloy properties remain the same for ALPHA SAC ULL.

Element	Specification %						
	SAC305	SAC387	SAC405	SAC300	SAC350	SAC380	SAC400
Sn	Balance	Balance	Balance	Balance	Balance	Balance	Balance
Ag	3.0 ± 0.2	3.8 ± 0.2	4.0 ± 0.2	3.0 ± 0.2	3.5 ± 0.2	3.8 ± 0.2	4.0 ± 0.2
Cu	0.5 ± 0.1	0.7 ± 0.1	0.5 ± 0.1	0.05 max	0.05 max	0.05 max	0.05 max
Pb	0.07 max	0.07 max	0.07 max	0.07 max	0.07 max	0.07 max	0.07 max
Sb	0.10 max	0.10 max	0.10 max	0.10 max	0.10 max	0.10 max	0.10 max
Zn	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max
Fe	0.02 max	0.02 max	0.02 max	0.02 max	0.02 max	0.02 max	0.02 max
As	0.03 max	0.03 max	0.03 max	0.03 max	0.03 max	0.03 max	0.03 max
Ni	0.01 max	0.01 max	0.01 max	0.01 max	0.01 max	0.01 max	0.01 max
Bi	0.10 max	0.10 max	0.10 max	0.10 max	0.10 max	0.10 max	0.10 max
Cd	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max
Al	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max	0.001 max
In	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max

All figures are in % for impurity limits per alloy in relation to J-STD-006C.

**Material Properties**

	SAC305	SAC387	SAC405
Melting Point	217 to 219 °C (423 to 426 °F)	217 to 219 °C (423 to 426° F)	217 to 219 °C (423 to 426° F)
Density	7.37 g/cm <sup>3</sup>	7.44 g/cm <sup>3</sup>	7.44 g/cm <sup>3</sup>
TCE (Range 20 to 100 °C) micrometers / M / °C	21.9	21.4	21.4
Specific Heat Capacity	0.232 J/g K	0.236 J/g K	0.236 J/g K
Hardness	14.1 HV	14.9 HV	14.9 HV

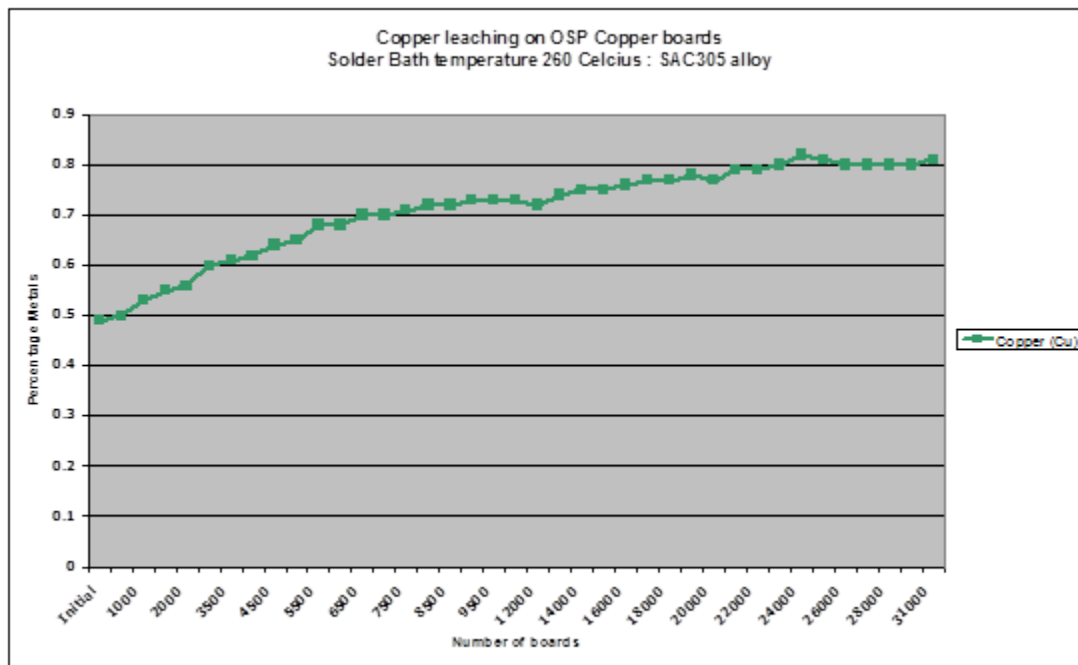
**RECOMMENDED WAVE SOLDER PROCESS SETTINGS**

Wave Configuration	Process Parameter	Suggested Process Settings
<b>Single Wave</b>	Pot Temperature	255 to 265 °C (491 to 509 °F)
	Conveyor Speed	1.0 to 1.5 m/min (3.3 to 5 ft/min)
	Contact Time	2.3 to 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
<b>Dual Wave</b>	Pot Temperature	255 to 265 °C (491 to 509 °F)
	Conveyor Speed	1.0 to 1.5 m/min (3.3 to 5 ft/min)
	Contact Time	3.0 to 3.5 seconds
	Wave Height	1/2 to 2/3 of board thickness
	Dross Removal	Once per 8 hour run time

These are general guidelines which have proven to yield excellent results. However, depending upon your equipment, components and circuit boards, your optimal settings may be different. To optimize your process, it is recommended to perform a design experiment, optimizing the most important variables (i.e., amount of flux applied, conveyor speed, topside preheat temperature, solder pot temperature, board orientation, etc.).

**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 ALPHA SAC305/387/405 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. A typical copper level increase is shown on the chart below:



This shows an average leaching rate of 0.01% Cu per 1000 boards. Each process is unique, and this is an indication only of the leaching rate (based on actual data).

It is recommended that the copper is controlled at between 0.5% and max 0.95% for ALPHA SAC305/387/405 alloys. 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 must be increased to maintain the process yields.

The copper levels in the bath can be controlled by means of adding the relevant replenishment alloy to the wave solder pot. It may be the case that equilibrium can be attained by continuing with replenishment alloy additions as the only means of solder top up. However, each process is unique, and we recommend regular analysis of the solder bath so that good control of copper can be maintained.

MacDermid Alpha offers solder pot analysis services. Contact your local office for details.

**RECOMMENDED ACTION LEVELS FOR WAVE SOLDER IMPURITIES**

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.

Element	ACTION Levels %	Notes
Sn	<b>BAL</b>	No Action levels.
Pb	<b>0.10</b>	RoHS Directive 2015/863/EU states a maximum Lead content of 0.1%
As	<b>0.03</b>	Levels greater than 0.03% can cause de-wetting.
Cu	<b>1.0</b>	SAC305/387/405 can operate at 1.00%, however for finer pitch assemblies bridging may increase at levels above 0.85%. SAC300 copper free should be added to maintain copper levels.
Bi	<b>0.20</b>	Lead Free alloys are tolerant to Bi up to 1.0%, however if levels above 0.20% are detected this indicates some contamination issues that should be investigated
Zn	<b>0.003</b>	Levels greater than 0.003% may cause increased bridging and icling, as well as increased crossing rates in the solder bath.
Fe	<b>0.02</b>	Greater than 0.02% Iron can be an indicator of pot erosion and may cause gritty joints and the formation of FeSn <sub>2</sub> IMC needles that can cause bridging.
Ag	<b>See Notes</b>	Silver levels of 4% are used in some SAC alloys, however if the Ag levels rise above 0.5% from the material specification, then some investigations should be held to establish the cause. Solderability should not be affected.
Sb	<b>0.20</b>	Lead Free alloys are tolerant to Sb up to 1.0%, however if levels above 0.20% are detected this indicates some contamination issues that should be investigated
Ni	<b>0.05</b>	Levels greater than 0.05% may start to slow wetting and may reduce hole fill. Evaluate soldering performance if levels exceed 0.05%. Locate and eliminate source of high Ni levels.
Cd	<b>0.003</b>	RoHS Directive 2015/863/EU states a maximum Cadmium content of 0.01%. Levels of 0.003% may cause higher level of bridging and icling.
Al	<b>0.002</b>	Levels greater than 0.002% may cause higher levels of bridging and icling and a greater level of surface oxidation in the solder bath.

**AVAILABILITY**

ALPHA SAC305/387/405 is available in 1 kg (2.2lb) Bars, feeder Ingots and auto feed wire. Most products are shipped strapped and palletized or packed in corrugated cardboard box. Inspect shipment to make ensure there is no apparent significant damage to shipping materials.

**RECYCLING SERVICES**

We provide safe and efficient recycling services to help companies meet their environmental and legislative requirements and at the same time, maximize the value of their waste streams. Our service collects solder dross, solder scrap, and various forms of solder paste waste. Please contact your local sales representative for recycling capabilities in your area or [link here](#).



**SAFETY & WARNING**

It is recommended that the company/operator read and review the Safety Data Sheets for the appropriate health and safety warnings before use. **Safety Data Sheets are available at [MacdermidAlpha.com/assembly-solutions/knowledge-base](http://MacdermidAlpha.com/assembly-solutions/knowledge-base).**

**CONTACT INFORMATION**

**To confirm this document is the most recent version, please contact [Assembly@MacDermidAlpha.com](mailto:Assembly@MacDermidAlpha.com)**

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Also read carefully warning and safety information on the Safety Data Sheet. This data sheet contains technical information required for safe and economical operation of this product. READ IT THOROUGHLY PRIOR TO PRODUCT USE . Emergency safety directory assistance: US 1 202 464 2554, Europe + 44 1235 239 670, Asia + 65 3158 1074, Brazil 0800 707 7022 and 0800 172 020, Mexico 01800 002 1400 and (55) 5559 1588

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