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TECHNICAL BULLETIN alpha®

# ALPHA® SACX® 0307, 0300

Lead Free Wave Solder Alloy

## DESCRIPTION

ALPHA SACX 0307 is a lead-free alloy suitable for use as a replacement for Sn63 alloy in the wave solder process. The SACX 0300 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 SACX 0307 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.

## 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 |



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## PROCESS SETTINGS

| | | |
|---|---|---|
| **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 |
| *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. In order 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 and board orientation, etc…).* | | |

## TECHNICAL SPECIFICATION

Complies with all requirements of RoHS Directive (Article 4.1 of the European Directive 2011/65/EU). Alloy specification for Maximum Lead (Pb) Content = 0.07%. SACX®0307 *is also available as a Ultra Low Lead (ULL) version which contains a maximum of 0.05% Pb. All alloy properties remain the same for SACX®0307 ULL*.

| Material Property | Units | Vaculoy SACX0307 |
|---|---|---|
| **Solidus** | Celsius | 217 |
| **Liquidus** | Celsius | 228 |
| **Hardness** | HV | 14.1 |
| **Density** | g/cc | 7.33 |
| **Specific Heat Capacity** | J/kg C | 0.17 |
| **Stress at MAX Load (N/mm$^2$)** | Mean | 29.5 |
| | Std Dev | 0.64 |
| **Elongation at failure (%)** | Mean | 21.8 |
| | Std Dev | 8.8 |
| **Thermal Expansion Coefficient** | (30 - 100C)/C x $10^{-5}$ | 1.79 |
| | (100 - 150C)/C x $10^{-5}$ | 2.30 |
| **Silver Content** | % | 0.3 +0.15/-0.05 |
| **Copper Content** | % | 0.70 +/-0.1 |
| **Lead Content** | % | Max 0.07% |

## AVAILABILITY

ALPHA SACX 0307/0300 is available in 1kg (2.2lb) Bar, chunks, Feeder Ingots and Autofeed Wire.

## HEALTH & SAFETY

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

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## MANAGEMENT OF COPPER LEVELS IN THE SOLDER BATH

**Copper should be controlled in the solder bath between 0.7% and 1.0%**

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 SACX 0307 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 SACX 0307 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 SACX 0300 to the wave solder pot. It may be the case that equilibrium can be attained by continuing with SACX 0300 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 Alpha**.** Please contact your local sales 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 | BAL | No Action level. |
| Pb | **0.10** | RoHS Directive 2011/65/EU states a maximum Lead content of 0.1%. |
| As | **0.03** | Levels greater than 0.03% can cause de-wetting. |
| Cu | **1.0** | SACX 0307 is tolerant to copper levels up to 1.0%, SACX 0300 copper free should be added to maintain copper levels. Levels above 1.0% may cause more bridging. |
| Bi | **0.20** | 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 | **0.003** | Levels greater than 0.003% may cause increased bridging and icicling, as well as, increased drossing rates in the solder bath. |
| Fe | **0.02** | Greater than 0.02% Iron can be an indicator of pot erosion and may cause gritty joints and the formation of $FeSn_2$ IMC needles that can cause bridging. |
| Ag | **1.0** | Silver levels of 4% are used in some SAC alloys, however if the levels in SACX 0307 rise above 1.0% then some investigations should be held to establish the cause. |
| Sb | **0.20** | 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 | **0.05** | 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 | **0.003** | RoHS Directive 2011/65/EU states a maximum Cadmium content of 0.01%. Levels of 0.003% may cause higher level of bridging and icicling. |
| Al | **0.002** | Levels greater than 0.002% may cause higher levels of bridging and icicling and a greater level of surface oxidation in the solder bath. |
| Au | **0.1** | At levels above 0.1% there may be some problems with joint strength. |