Lead-free Alloys for Wave and Dip Soldering Process

Lead-free ELSOLD alloys are particularly suited as replacement for conventional lead-bearing alloys having been used up to now for wave and dip soldering. Due to the purity of the raw materials used impurity levels of the finished products are much lower than the limits admitted by the relevant norms. This leads to longer useful life of the solder bath and to a marked reduction in dross formation.

Due to their special manufacturing process ELSOLD lead-free solder alloys substantially reduce solder defects like bridges and icicles when compared to competitive products. This results in less rework and thus leads to a higher productivity in the printed circuit board assembly.

ELSOLD Lead-free alloys are available in 3 groups:

Tin-Silver Alloys: ELSOLD SA

Tradename	Sn [%]	Ag [%]	Density [g/cm³]	Melting point / -range [°C]
ELSOLD SA03	99.7 ± 0.2	0.3 ± 0.2	7.3	221 – 231
ELSOLD SA30	97.0 ± 0.5	3.0 ± 0.2	7.3	221 – 224
ELSOLD SA35	96.5 ± 0.5	3.5 ± 0.2	7.35	221
ELSOLD SA38	96.2 ± 0.5	3.8 ± 0.2	7.36	221 – 238
ELSOLD SA50	95.0 ± 0.5	5.0 ± 0.2	7.39	221 – 240

Tin-Copper Alloys: ELSOLD SC

Tradename	Sn [%]	Cu [%]	Density [g/cm³]	Melting point / -range [°C]
ELSOLD SC07	99.3 ± 0.5	0.7 ± 0.2	7.32	227
ELSOLD SC30	97.0 ± 0.5	3.0 ± 0.5	7.35	227 – 310

Tin-Silver-Copper Alloys: ELSOLD SAC

Tradename	Sn [%]	Ag [%]	Cu [%]	Density [g/cm³]	Melting point / -range [°C]
ELSOLD SAC0307	99.0 ± 0.5	0.3 ± 0.2	0.7 ± 0.2	7.33	217 – 227
ELSOLD SAC107	98.5 ± 0.5	1.0 ± 0.2	0.7 ± 0.2	7.36	217 – 223
ELSOLD SAC305	96.5 ± 0.5	3.0 ± 0.2	0.5 ± 0.2	7.37	217 – 219
ELSOLD SAC3507	95.8 ± 0.5	3.5 ± 0.2	0.7 ± 0.2	7.40	217 – 219
ELSOLD SAC3807	95.5 ± 0.5	3.8 ± 0.2	0.7 ± 0.2	7.40	217

Other Lead-free Alloys available on request

Alloys meet and exceed the requirements of relevant standards (DIN EN) ISO 9453, DIN EN 61190-1-3, ELSOLD House norms. Typical impurity levels are well below limits of common standards.

Forms of Delivery

Standard	Dimensions [mm]	Weight / unit
Solder bars with suspension eyelet	50 (W) x 18 (H) x 600 (L) 50 (W) x 20 (H) x 490 (L)	approx. 4.3 kg approx. 3.7 kg
Triangular bars	8 (W) x 10 (H) x 400 (L)	Bundles of 25 kg
Clippings	8 (W) x 10 (H) x 30 (L)	Bulk material
1 Kg bars	20 (W) x 20 (H) x 335 (L)	approx. 1 kg

More designs available including wires, threads, rods, etc…

Impurities of Lead-free Solder Alloys

Element	Maximum per (DIN EN) ISO 9453 [%]	Typical level as supplied by ELSOLD [%]	Level for replenishing or replacement (recommended) [%]	Critical level [%]	Comments
Sn	Nominal content ± 0.5	Nominal content	- / -	- / -	- / -
Ag	Nominal content ± 0.2 or 0.10 for Ag-free alloys	Nominal content or 0.005 for Ag-free alloys	- / -	- /-	Silver does not affect the characteristics of the solder up to approx. 2 %. Beyond this level the solder surface becomes grainy and rough
Cu	Nominal content ± 0.2 or 0.05 for Cu-free alloys	Nominal content, or 0.006 for Cu-free alloys	0.85	1.1	Cu leaching from board surfaces and component leads increases the copper concentration. Replenishing with SnAg or Sn99.9 is recommended over 0.9 %. Some processes may run with higher Cu concentrations, however, at higher temperatures.
Pb	0.10	0.05	0.1	0.1	RoHS Limit is 0.1 %. Soldering problems (formation of low-melting PbBi phases) should not normally occur under 0.3 % lead content.
Zn	0.001	0.0008	0.002	0.005	Zinc is can cause bridges and icicles. From 0.004 % up a grainy appearance and – in the worst case – a reduction of mechanical stability can occur.
Cd	0.002	0.0002	0.003	0.005	RoHS limit is 0.01 %. Cd causes bridges and icicles.
Sb	0.10	0.015	0.2	0.5	Possibly negative effect on solder spread.
As	0.03	0.005	0.03	0.05	Arsenic can have a negative impact on wettability from approximately 0.03 % up.
Fe	0.02	0.003	0.03	0.04	Grainy appearance of the solder surface is possible from Fe concentrations of 0.03 % and more.
Bi	0.06 – 0.10 depending on alloy	0.004	0.2	0.4	In low concentration levels Bi has a positive influence on solderability and fatigue behaviour. In the transition phase to lead-free alloys, however, care has to be taken since even small concentrations in the solder may lead to low-melting phases.
Al	0.001	0.0002	0.003	0.005	Even small concentrations can increase the dross formation and hinder wetting.
Ni	0.01	0.001 0.05 for micro-alloyed solders	0.05	0.1	Higher concentrations can cause brittleness of solder joints. Causes in low concentrations reduction of copper dissolution
In	0.10	0.004	- / -	- / -	Negative effects are not known.
Au	0.05	0.0005	0.1	0.3	The solder viscosity increases from gold in concentrations of 0.2 % and higher. Solder joints get a dull appearance.

Application

Due to the low density of lead-free alloys they show a different behavior when the boards leave the wave relevant changes to the angle (approx. 2 ° higher) have to be made.

Depending on the exact alloy and components used the recommended operating temperature should be adjusted between 250 und 275 °C.

To reduce dross formation, especially for those processes run in normal atmosphere, we recommend to use Deoxidation Tablets made from Sn99P1. These tablets provide an optimum surface tension of the solder bath and further reduce formation of icicles.

ELFLUX offers a wide range of Fluxes for the optimization of your soldering process. For details please review the relevant product data sheets.

Shelf Life

Materials can be stored for a minimum of 5 years in a clean, cool and dry environment.

Marking

ELSOLD Lead-free bars are marked with the ELSOLD Smiley in order to avoid mixing with lead-bearing material.

Service

ELSOLD offers analytical service for your solder pot. Within 48 hours at the latest our laboratory will advise customers of the exact composition and impurity levels of the submitted sample

ELSOLD also offers to dispose of unusable spent solder materials and credit a residual value to the customer. However, a minimum of 250 kg per lot should be observed for economical reasons. Please, contact your partner at ELSOLD for further information.

Safety and Health

For information regarding health and safety please refer to the relevant material safety data sheet.

The technical information contained herein is consistent with the properties of this material but should not be used in the preparation of specifications as it is intended for reference only.