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Strip shelf life

Visual appearance and solderability

Introduction

During the production process, the properties of copper alloy strip are adjusted according to the customer's specification, and measured values are provided in a certificate of conformity. The supplied strip is also expected to have specific characteristics regarding the surface appearance and solderability. These properties and characteristics should remain consistent from the time when the material is packed, transported, until material arrives at the customer including a certain storage period.

Wieland applies protective measures to maintain the product characteristics and prevent them from being adversely affected. Examples of measures include (but are not limited to): oiled surfaces as protection against fretting corrosion and moisture absorbing sea-worthy packing. Besides applying protective measures, it is strongly recommended to ensure favourable storage conditions, to keep the packaging sealed during storage and open it only just before the strip is further processed.

Despite all measures both, surface appearance and solderability, will change over time and are dependent on storage conditions. The storage period includes the transportation time. This leaflet provides information about optimum storage conditions, along with factors influencing the shelf life and solderability of bare and plated copper alloy strip.

Storage

The storage conditions such as time, temperature, humidity, environmental conditions, atmosphere and packaging affect the subsequent processing and function of the bare and tinned material, or stamped parts and components and are critical to the shelf life of the products.

The aging mechanisms during storage and processing influence the following:

- solderability by oxidation and growth of intermetallic phase
- contact resistance by oxidation
- formability of tin coatings due to growth of intermetallic phase

The severity of effects from these mechanisms depends on the processing steps and parameters, such as forming process and degree of cold work in the material as well as soldering method and soldering temperature.

Ideal Storage Conditions

Temperature:
- max. 8 °C variation within one day
- winter mean 15 °C, summer mean 24 °C
- min. 10 °C, max. 30 °C

Relative humidity:
- max. 20 % variation within one day
- winter mean 50 %, summer mean 60 %
- max. 75 %

First-In-First-Out (FIFO) storage should be practiced. Strip should remain wrapped in original Wieland Safe Pack VCI foil after oversea shipment.

Solderability

Solderability is not a material property. It depends on many factors, most of which are controlled by our customer. Type of flux, component width and specimen width, the surface to be soldered and the soldering temperature have a significant influence. Larger areas and volumes are more difficult to process due to the heat dissipation. If solderability is required, this must be specified. Ideal storage conditions are crucial.

The information provided in this leaflet refers to soldering with SnAg4Cu solder (SAC). Tests with SnPb40 solder can be carried out upon request.

Solderability Test

The solderability of a surface is defined by its solder wetting characteristics. For testing the solder wetting characteristics, Wieland uses the two most common methods:

- In the dip-and-look method, according to DIN EN IEC 60068-2-20, the specimen is dipped into the SnAg4Cu solder (SAC solder) at 260 °C / 245 °C and a dipping speed of 25 mm/s. The physical and visual characteristics determine if the specimen has passed or failed this test.

  Note that DIN EN IEC 60068-2-20 only refers to leads of electronical components, while the tests in the laboratory are carried out on strip specimens.

- The wetting balance analysis, according to DIN EN 60068-2-54, is a quantitative test used e.g. for pins. It measures the wetting forces exerted by the molten solder on the test surface as it is dipped into and held in the solder bath as a function of time. The solderability test should be carried out within two weeks after receipt of goods.

Evaluation of Solderability Results

The following tables in this leaflet provide reference values in the form of score, for the solderability of bare and hot-dip tinned strip under ideal storage conditions and as a function of storage time. All results have been obtained from the vertical dipping test, according to DIN EN IEC 60068-2-20, carried out on 10 – 30 mm wide specimens. It has to be taken into consideration, that a slightly pimpled solder surface is not a negative criterion, as this occurs with lead-free solders during cooling. The information with regard to soldering after aging only refers to aging for 16 h at 155 °C dry heat (aging test Bb), see DIN EN IEC 60068-2-20 chapter 4.1.1, aging procedure 3b.

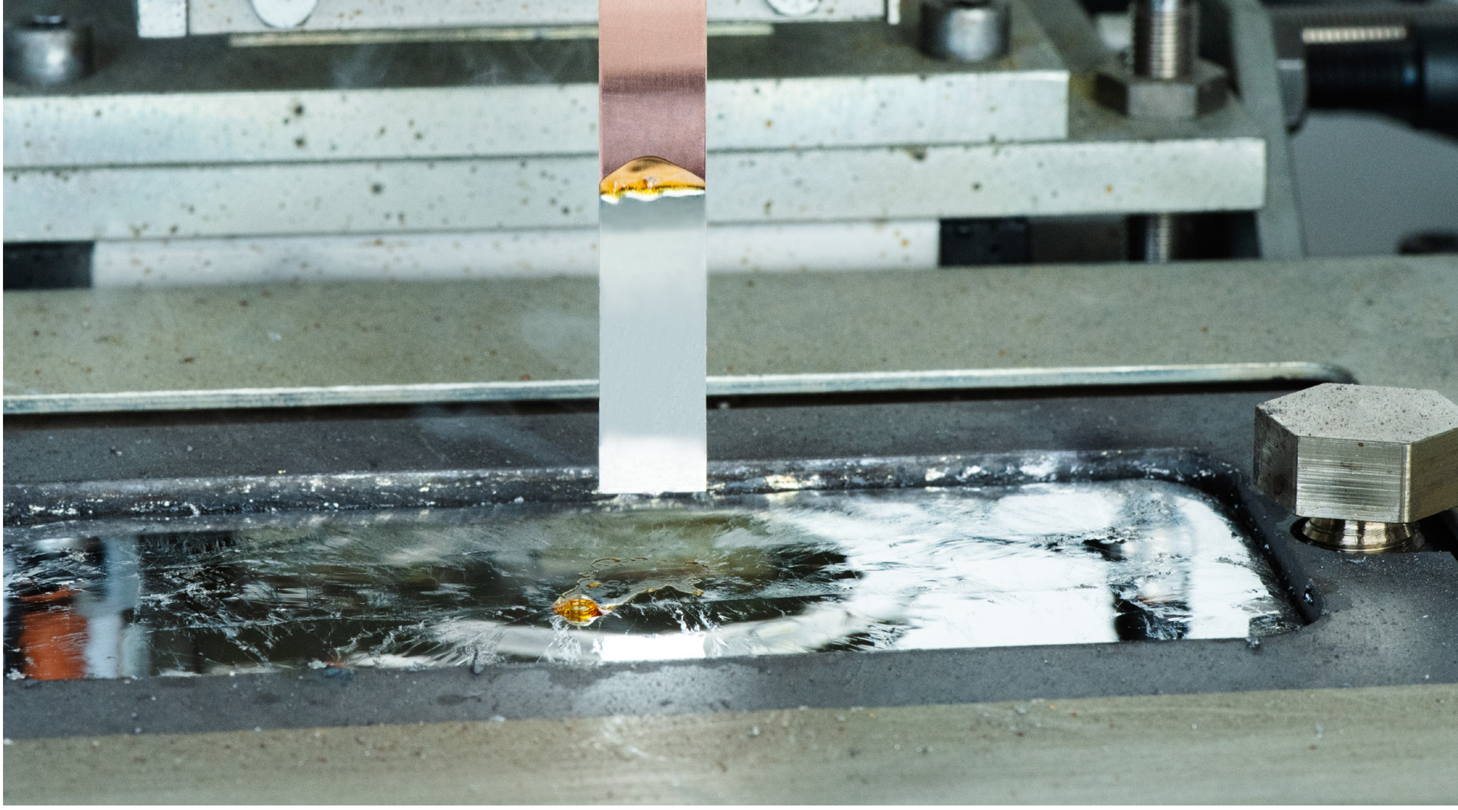
a) Bare Strip

The solderability test results of bare copper alloy strip, using a slightly activated flux and based on IEC 60068-2-20, depending on different previous storage durations as well as evaluation scores are shown in Table 1. Surface treatment of bare strip with benzotriazole is a standard at Wieland. Benzotriazole forms a protective film on copper and its alloys which ensures temporary protection against corrosion and tarnishing (chemisorptic activity).

Table 1:

Alloy	Storage time				
	2 weeks	1 month	6 months	12 months	18 months
Copper	A	A	B	C	C
Brass M10, S12	A	A	B	C – D	C
Brass M30, M38	B	C	D	D	E
Bronze B14/16	A	B	C	D	D
L49	A	B	B – C	C	D
Nickel silver	B	B	B	D	D
K65, K80, K81	A	B	C	C – D	C – D
K55, K57, K75, K88	A – B	B – C	C – D	D	D
S23	C	C – D	D – E	E	E

A: ideal, B: good, C: acceptable, D: unacceptable, E: no adhesion of solder to metal surface



Solderability test according to DIN EN IEC 60068-2-20

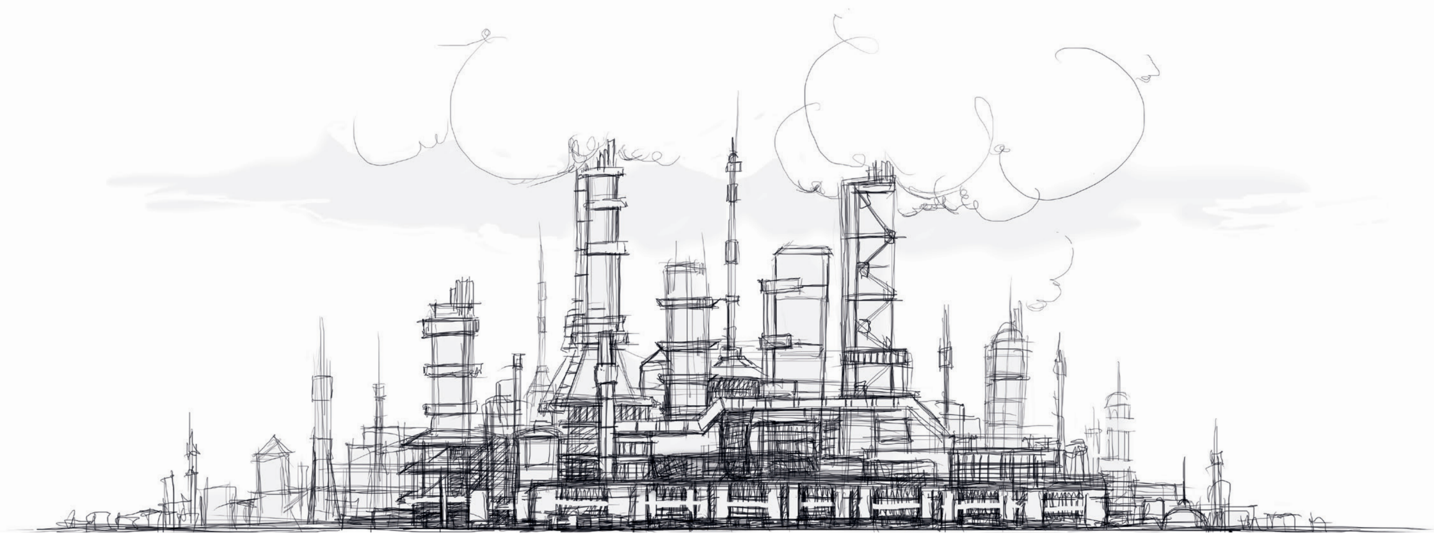
b) Hot-dip tinned strip

Table 2 shows evaluation scores for solderability test results of hot-dip tinned copper alloy strip based on IEC 60068-2-20 depending on different previous storage durations. These scores are valid for Wieland coatings SnPUR, thickness of 3 – 5 µm. Strip with a coating thickness <3 µm is solderable only for a short time. Solderability with SnTOP may be slightly better. SnTEM is not solderable. Strip with a thickness > 1 mm must be downgraded by one score.

Table 2:

Alloy	Storage time					
	2 weeks	1 month	6 months	12 months	18 months	2 weeks – 2 months + aged at 155 °C/16 h
Copper	A	A	B	B	C	C
Brass M10	B	B – C	B	C	C	C
Brass M30	B	C	C	C	D	C
Bronze B14/16	A	A	A	B	B	B
L49	A	B	B	B	B – C	C
Nickel silver N12	B	B	C	C	C	C
K65, K80, K81	A	A	B	B	B	B – C
K55, K57, K75	A	A	B	B	D	B

A: ideal, B: good, C: acceptable, D: unacceptable, E: no adhesion of solder to metal surface



c) Hot-dip tinned strip after storage in harsh atmospheres

If storage conditions are harsh, e.g. if the strip is stored in industrial atmosphere, shelf life is reduced. Table 3 shows the solderability test results (according to IEC 60068-2-20) of hot-dip tinned copper and copper alloy strip (SnPUR, thickness 1 – 5 µm) as a function of different previous storage durations in various harsh atmospheres as well as evaluation scores.

Table 3:

Hot-dip tinned strip	Coating SnPUR®	Storage conditions and duration of atmospheric exposure in months								
		Severe industrial atmosphere, e.g. inside production plants			Mild industrial atmosphere			Laboratory aging test (38 °C, 85 % rel. humidity)		
	µm	3	6	12	3	6	12	3	6	12
Copper	1 5	B A	C B	D C	A A	C B	D B	D A	D B	D B
Brass M30	2,5 5	D D	D D	D D	C C	C C	D D	D C	D D	D D
Nickel silver	2,5 5	D C	E D	E D	C C	D C	D D	C C	C C	D C

A: ideal, B: good, C: acceptable, D: unacceptable, E: no adhesion of solder to metal surface

Tarnish Resistance

Copper alloys exhibit good corrosion resistance in numerous media. This is based on a natural process. In the atmosphere, an oxide layer forms on the surface, which strongly retards further oxygen attack. Depending on environment and duration, this oxide layer may change the surface appearance. To restore the functionality of the surface, it is mostly sufficient to activate it by using a flux. Table 4 shows evaluation scores for the tarnishing of bare copper and copper alloys strip under ideal storage conditions. Note: bare strip surfaces are standardly treated with benzotriazole, a temporary corrosion protection film.

Table 4:

Alloy	Storage time			
	3 months	6 months	9 months	
Copper	A	B	B	Affected by pollutants and other environmental factors. Hydrogen sulphide causes rapid tarnishing.
Brass M10	A	B	B	
Brass M30	B	C	D	Affected by pollutants and other environmental factors. Hydrogen sulphide causes rapid tarnishing. Sulphur dioxide, nitrogen oxides and ammonia may cause stress corrosion cracking.
Bronze	A	C	D	Affected by pollutants and other environmental factors. Hydrogen sulphide causes rapid tarnishing.
Nickel silver	B	B	D	
Hot-dip tinned strip	A	B	B	

A: ideal, B: good, C: acceptable, D: unacceptable

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