PMX INDUSTRIES, INC.

Precision Coatings

Hot Tin, Tin Silver Sn28M, Advanced Tin

Connectors, switches and relays are a part of our every day lives. The devices and vehicles we rely on every day need high quality and reliability created in part by tin coatings. Traditionally the coating and base metal have been considered and specified separately. Today, with ever increasing demands it has become important to consider the base metal and coating together as a system.

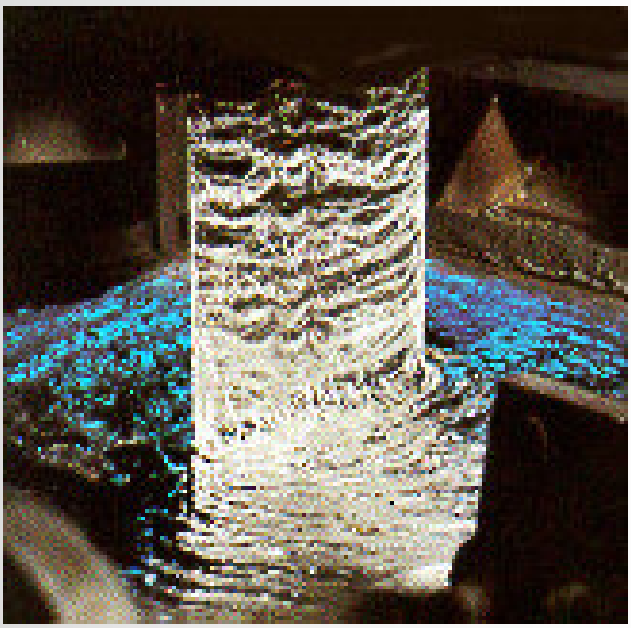
To that end, PMX and our global partners have developed base metal/coating systems that work in harmony to deliver the best performance available today without the use of precious metal.

Designers and engineers are challenged to select materials that will not only meet the needs of the consumer, but also stand up to the challenges of the operating environment . Insertion force management, multiple connect/disconnect cycles, wide temperature ranges, vibration, and contact resistance must be considered. In addition, at higher operating temperatures (>120°C), interactions between base metal and coating as well as surface oxidation must also be considered. Green initiatives including RoHS and recyling mean solutions should work without impact to the environment.

Tin is the most commonly used metal to plate copper-based alloys for these applications. The reasons can be corrosion protection from harsh environmental conditions, enhanced electrical performance, the need for good solderability or a combination.
Tin, however, is not sufficient to perform in more advanced designs. Further, the performance of pure tin requires sufficient contact force to maintain low contact resistance and resistance to fretting. This combined with high coefficient of friction, means tin has significant limitations.

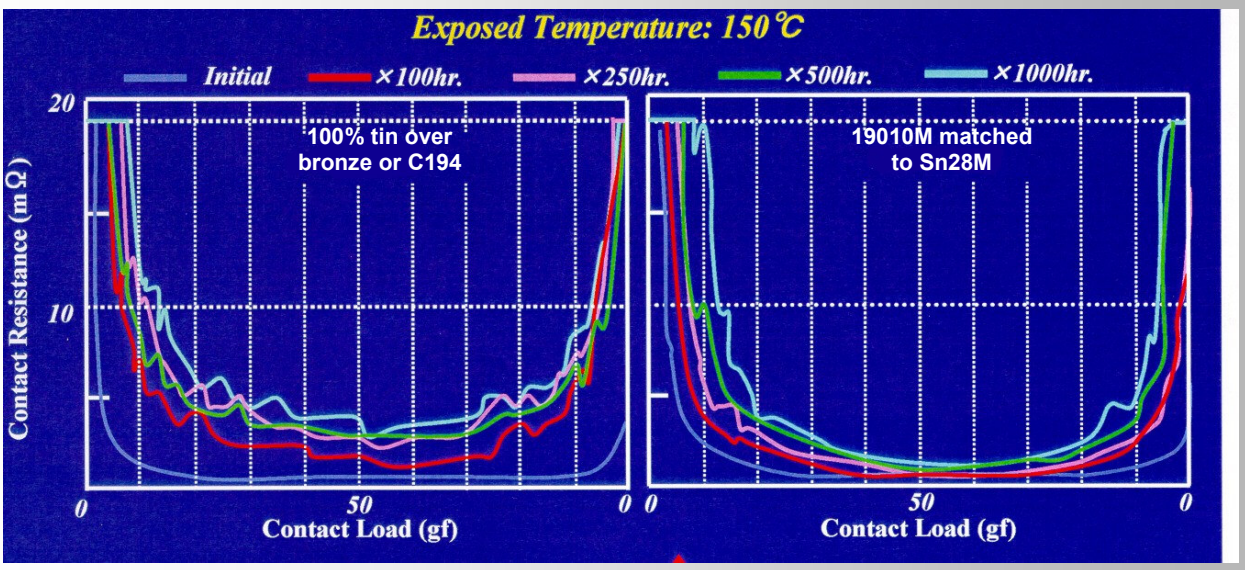
To overcome the limitations of tin, PMX and our global partner, KM Europa developed Advanced tin alloying systems (Sn28M and Sn13) which when combined our XP family of copper alloys produce a combination of low insertion force, no whiskering and high temperature reliability. Automotive interconnects use these base metal/coating systems to achieve reliable performance at over 140°C continuous operation (US Car Cat III-Cat IV).

Integration of both products into our quality management system insures you get the right product every time.



Two methods	Available coatings
• By mechanical wiping • Hot Air Level - HALT	PMX HALT - 100% tin, Lead Free STOL®Sn28 - hard, Pb-free, high temp STOL®Sn28M - tin-silver, Pb-free, High temperature Low Insertion Force STOL®Sn13 – thermic tin, Pb-free Low Insertion Force High Temperature

Contact resistance stability is an important characteristic of all tin and tin alloy coatings. Figure 1 below shows that performance over time with coating applied to a standard alloy and when optimized with our specially designed XP base metal alloys. Note the instability of standard alloys which have not addressed the mechanisms which can generate peeling of the coating. While field failure of the coating may not be evident, the decreased contact resistance performance can threaten the signal/noise ratio or the interconnect reliability of the system over time. Ask your representative about our specially designed alloys 19010M, 64725, 70310, 18665 and others.



What can happen when you don't utilize the PMX System

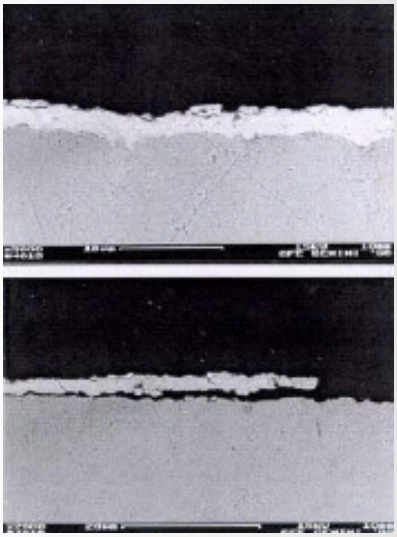


Figure 2: Cross Section: 500 hrs @ 150°C. Showing tin peeling due to an improperly engineered base metal—coating system.

Performance Selector Various Tin Coatings

Kind of test	importance	Pure tin	Sn28	Sn28M	Sn13
Micro hard-ness	high	+	++	++	+++
Mating and un-mating force	low	+	++	++	+++
Soldering	good	++	+	+++	+
Electrical Stress test	good	+	+	+++	+++
Fretting	low	+	+	+++	+++

Types of Tin Coatings:

Hot Dip Tin – Mechanical Wipe – Commercial Coat **Thickness: 20 min, 20-80, 20-100, 20-120**

Obtained with a molten bath of tin . Thickness control is achieved by using wipers and controlled pressure to remove the excess tin. Uniform, bright, non-solderable coating. Whisker free. High contact forces required to achieve good contact resistance.

Hot Air Level Tin (HALT) and Sn28M **Standard Thickness: 40-80, 40-120, 50-150, 100min. and others**

Obtained with a molten bath of tin . Thickness is controlled with non-contact air knife. Whisker Free. Uniform, bright coating with a controlled layer of free tin providing superior solderability and low contact resistance. Sn28M optionally provides reduced insertion force and stability at operating temperatures above 140C when used in conjunction with our specially formulated alloys like 19010M, 18665, 64725, and 70310. Tin-Silver coatings available in a range 1-7% silver.

Electro-Tin – Matte

Achieved by electro-deposition of metallic tin ions from aquious bath. The matte finish shows physical burnishing and contact more than hot dip and provides good solderability.

Electro-Tin – Brite

The process is the same as for the Matte-Electro-tin above. The brite finish is achieved by the addition of organic chemicals which modify the deposited tin structure to be more reflective. The coating is generally harder but more esthetically pleasing. There may be wettability issues and tarnishing under certain conditions due to the effect of the brighteners, but this coating can be soldered with care.

Electro-Tin – Reflow

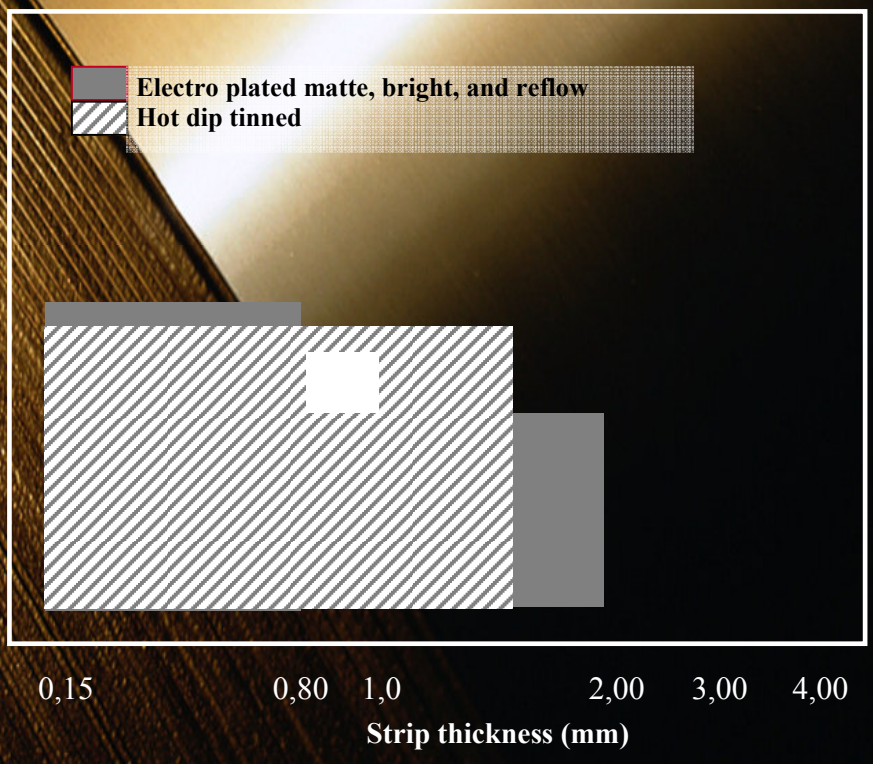
Specially deposited tin is electro-deposited to the strip which is fed through a heat source and the tin is reflow melted. Uniform, bright surface which is solderable. Whisker free. Shelf life of this product is not as good as Air Wipe Tin and Sn28M.

Hot dipped (inhouse)

- Gauge Range :0.006“ to 0.0395“
- Coating Thickness
  - 0,8-2; 1-3; 2-4; 3-6; 4-10µm
- Strip Width: up to 14“
- Coating Chemistries:
  - 100% tin, Sn28M tin silver, Low insertion force tin (SALT), RoHS leadfree

Electro plated

- Gauge Range: 0.004“ to 0.094“
- Strip Width: up to 14“
- Sn, Cu, Ni, Au, Ag and combinations
- Reflow



PMX Industries, Inc.

PMX Industries, Inc
5300 Willow Creek Drive
Cedar Rapids, IA 52404
Telephone: 319-368-7700, 800-531-5268
Fax: 319-368-7721
Internet: www.ipmx.com