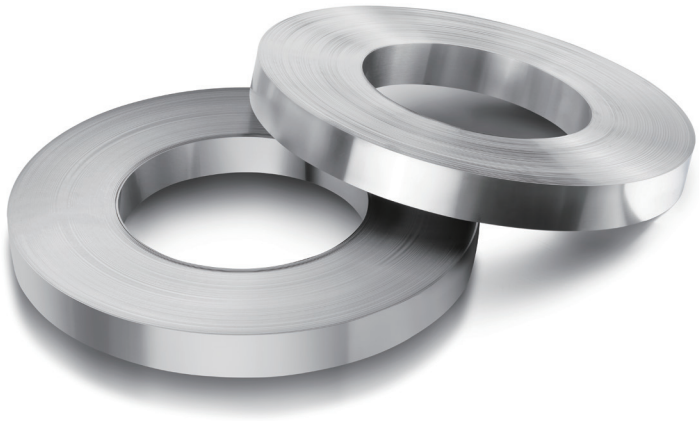
boway



# HOT DIP TINNED STRIPS

Hot Dip Tinning (HDT) is a particularly economical process to produce such coatings with an excellent balanced performance spectrum

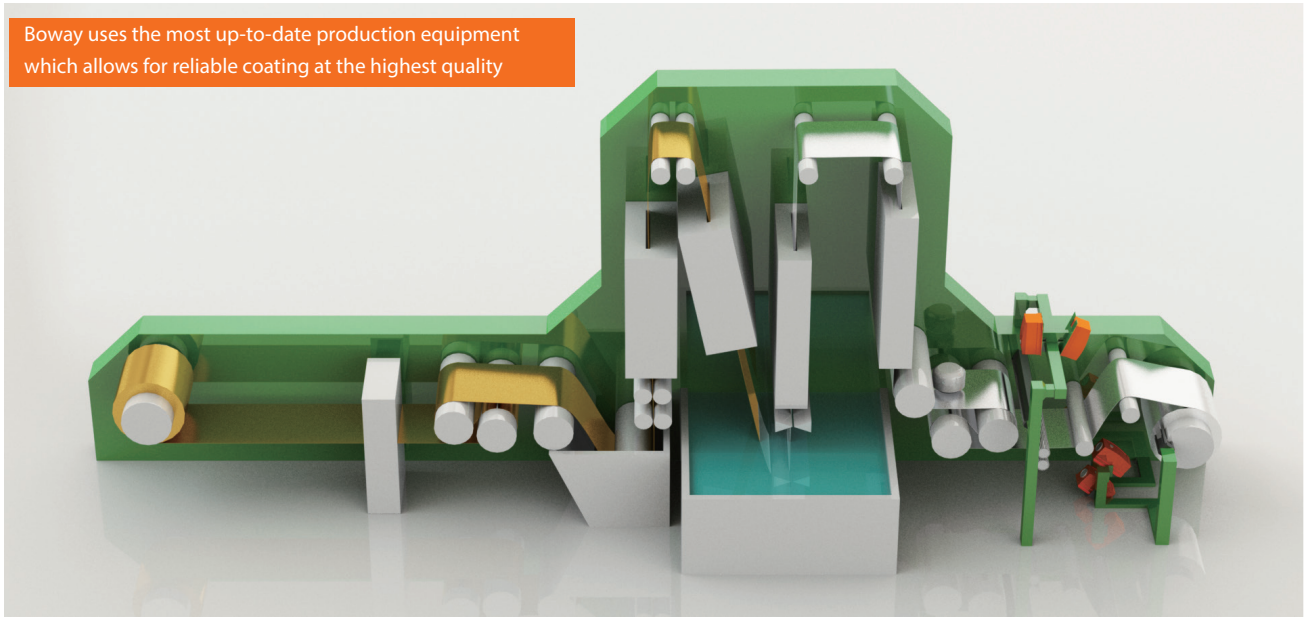
## Hot Dip Tinning (HDT)

Copper and copper alloy strips are the ideal base material for connectors for electrical and electronic applications. However, bare copper forms oxide layers over time, which can disturb or even prevent reliable contact. The right coating ensures that the mechanical and electrical requirements at the contact point are met in the long term. HDT is a particularly economical process to produce such coatings with an excellent balanced performance spectrum.

## HDT Process

- HDT is a high-speed process in which a complete coil is coated in one pass.
- For this purpose, the copper strip is guided at high speed through a flux bath and then traversed through a trough containing a tin melt.
- Boway produces HDT strips using the Hot Air leveled Process (HALT):

Immediately after exiting the Sn bath, the liquid tin adhering to the strip surface is blown off without contact using compressed air (so-called air knifes) to the desired coating thickness. The strip then passes through a cooling section in which the tin finally solidifies. During the tinning process, the coating thickness is continuously measured using an X-ray fluorescence detector and the coating thickness setting for the air knives is permanently adjusted. A high-end surface inspection system is used to check and record the surface quality before recoiling. Finally, the strip is cut to the desired dimensions in a separate processing step.



Boway uses the most up-to-date production equipment which allows for reliable coating at the highest quality

## The Sn-Coating

- During the tinning process, diffusion processes occur at the contact zone between the strip material and the liquid tin, and copper and tin react with each other. After solidification, an intermetallic compound (IMC) with the stoichiometric compositions $Cu_6Sn_5$ and $Cu_3Sn$ are present between the tin coating and base material.

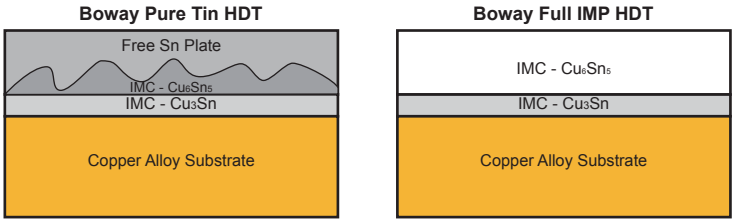


Fig: 1 Schematic Cross secitions thru HDT strip

- The tin layer protects the base material from oxidation. Tin is a non-precious metal and tends to oxidize itself. The oxide forms a protective layer that prevents the tin coating from further oxidation. The free tin on the top surface is soft and ductile, while the IMCs are hard and wear resistant. This makes it possible to optimize the properties of the coating for the intended application.

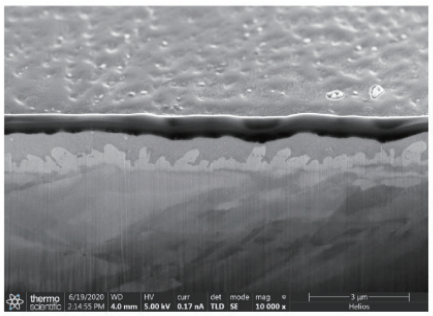


Fig: 2 Boway Pure Tin HDT on boway 19005- FIB cut

## The Properties

The layer structure enables the excellent balanced performance of HDT coatings. In the contact area of a connector, the tin layer is plastically deformed so that oxides are displaced and a good connection with low contact resistance is ensured even at low contact forces. The IMC is hard and wear resistant and provides the adhesion of the tin to the base material. Tin coatings exhibit only very low residual stresses and thus have excellent resistance to whisker formation. For this reason, whisker formation in HDT coatings can only be caused by externally induced stresses, which can be safely limited by suitable design measures. Thick coatings may also exhibit excellent solderability.

## HDT Strip Tolerances

- Boway uses high-precision equipment which allows achieving tightest tolerances and most competitive geometric properties. Boway can achieve tolerances far tighter compared to international standards.
- By standard tolerances for HDT strip are based on bare strip tolerance + HDT tolerances.
- Hardness, solderability, insertion and withdrawal forces and wear resistance can be controlled to a certain extent by the coating thickness.

| Typical Thickness Ranges | Hardness Indicator | Good for |
|---|---|---|
| 1-2 µm | Hard | Low insertion / Withdrawal force<br>Low wear |
| 1-3 µm<br>2-4 µm | Medium | Standard automotive connector thickness |
| 3-6 µm | Softer | Min. thickness for solderability |
| 4-8 µm<br>8-12 µm | Softer | Solderability |

## Hardness & Solderability

- Typical thickness ranges and the resulting properties are shown as examples in Fig. 3.

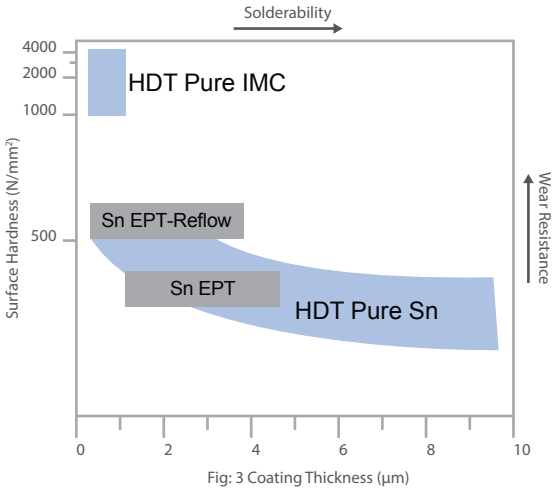


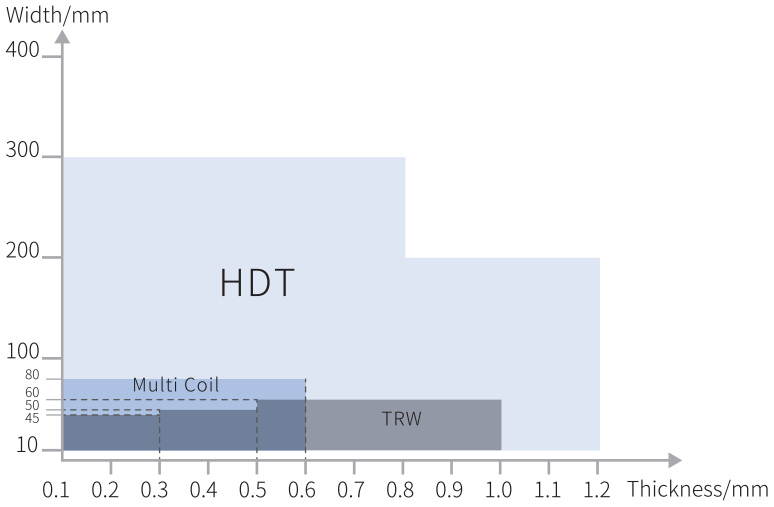
Fig: 3 Coating Thickness (µm)

## Comparing HDT vs. EP Sn Coatings

| Plating/Property | HDT Sn | HDT IMC | EP Reflow | EP |
|---|---|---|---|---|
| Layer System | IMC/free Sn | 100 % or partly IMC | IMC/free Sn | Sn with or W/o Cu flash |
| Passivation | No- Oil | No-Oil | No-Dry | No-Dry |
| Temperature usage up to | 130°C | 150°C | 130°C | 120°C |
| Danger against whisker | No | No | No | Yes |
| Min. contact force required | > 1 N | > 3 N | >1 N | >1N |
| Fretting corrosion sensitive | Yes | Yes | Yes | Yes |
| Micro-Hardness range UH | 250-500 | 2000-4000 | 300-600 | 250 |
| Key feature /typical | Low-cost coating, crystallizing structures visible | High hardness, brittle crystallizing structures visible, low bendability | Visual appealing | Matt ( bright = high contact resistance!) |

## Delivery Forms

HDT strips are manufactured according to customer requirements in strip thicknesses from 0.1 to 1.5 mm with layer thicknesses from 0.8 µm to 12 µm. Possible strip widths range from 10 to 400 mm. Delivery forms are strips on coils, boway multiple coil or spooled strips. Please refer to figure 4 and 5 for dimensions and delivery options.



Remark: For areas beyond the shadow range of the graph, you can contact our engineers for trial production.

Fig: 4

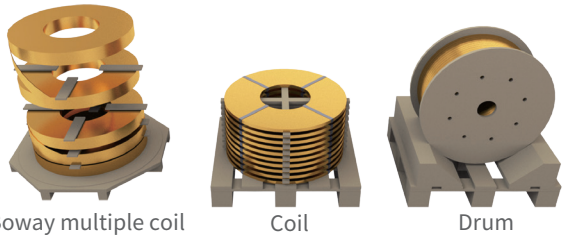


Fig: 5