Micro Metal Parts And Terminals: Attributes Of A Controlled Finished Surface Suitable For Wire Bonding

There are a number of considerations in part configuration and finish to achieve good electrical conductivity in wire bond applications. Many of these features can only be accomplished by cold forming. Stamping and shearing, for example, will often distort the part geometry, making for an inferior contact surface. However, even cold formed parts can have flaws. A perfect part depends significantly on the skill and care of the tooling designer and manufacturer, as well as on a reliable and consistent quality program.

Part and finish attributes that are best suited for high quality wire bond applications include the following:

- Finish should be consistent across the entire target surface.
- Finish should be smooth with no pock marks, ridges, or laminated striations to interrupt the surface finish.
- Finish should cover the entire surface area across the wire bond target area. For example, on circular surfaces at the end of a terminal wire, the target area should be 100% of the theoretical circle, with no edge break. Sharp edges should be present to offer 100% of the surface as the target for wire bonding.
- No burrs should exist anywhere that would project from the wire bond area.
- For "cored" (bi-metal) terminals in particular, such as the pins pictured in Example #3 where the wire bond surface must be consistent across two different materials, there should be no separation or voids between the outer (Kovar) diameter and the inner (copper) core.

Following are several examples of parts illustrating attributes with good and not-so-good qualities.

Example #1: Terminal Pin for Hermetic Seal Application

Description: .018" +/- .0003" (.45 mm) diameter pin

Material: Glass sealing 52 alloy

End condition #1: Spherical radius

End condition #2: Flat wire bond surface

Photo #1: .018" side view showing well-formed sharp edges and corners

Example #1: Terminal Pin for Hermetic Seal Application, Continued

Photo #2: .018" head-on view of wire bond

Photo #3: .018" 45 degree view of wire bond end. Perfectly formed, flat, evenly finished, sharp edges are ideal for bonding

Example #2: Terminal Pins for Hermetic Seal Application; Bi-Metal Copper-Cored Wire

Description: .040" +/- .0003" (1.0mm) diameter pin

Material: Copper Cored Nickel Alloy (52 alloy per ASTM F30)

End condition #1: Radiused

End condition #2: Flat wire bond surface

Photo #4: .018" 45 degree view of wire bond end. Perfectly formed, flat, evenly finished, sharp edges are ideal for bonding

Example #3: Terminal Pins – Comparison of 4 Different Finishes in Bi-Metal Copper Cored Wire

Photo #5: Comparative view of four different pin surfaces

Optimal – Pin Surface A (far left view)

- Note the fine (RMS 20/Rz 3.1) finish across both the copper area as well as the Nickel/Iron alloy sheath around the copper.
- Note that the copper core is centered in the middle of the OD.
- Note the consistent finish across the entire surface; finish is the same on the copper as on the Nickel/Iron sheath.
- Note the absence of pitting, or separation between the copper & Nickel/Iron alloy.
- Note that the wire bond surface is complete across the entire diameter of the pin end. There is no die roll-over, burr, or radiused/broken edge on the OD; the entire surface is available as a wire bond target.

Very Good – Pin Surface B (2nd from left)

- Note that the finish (approx. RMS 30/Rz 4.7) is somewhat rougher than on part A, otherwise this is identical to part A. This finish can be held from lot to lot and serves as an example of common surface finishes that can be offered for very good results.

Flawed – Pin Surface C (3rd from left)

- Surface shows the common “shear cut” surface finish, normally the least desirable of the finishes.
- Note the uneven surface between the Nickel alloy sheath and the copper center.
- Note the difference in surface finish appearance from the copper surface (in center) to the Nickel Iron
- Not that this finish produces an inconsistent surface across the diameter, which may cause issues with wire bonding.
- Note the copper core is distorted and somewhat off center from the outside diameter.

Flawed – Pin Surface D (far right)

- This depicts a cold formed headed pin, viewing the top surface of the “head”.
- Note the off-center copper core which has been distorted on the surface.
- Note the small difference in surface finish between the copper and the Nickel Iron alloy surface, a slight inconsistency in surface finish, but an improvement over pin surface C.

Example #4: 015" diameter Kovar (Nickel cobalt alloy) RF pin with a "notched" wire bond end

Photo #6: A very small diameter pin, at .015" (.38 mm) OD.

Optimal – Pin Surface A (far left view)

- Note the fine and consistent surface finish on the flatted end.
- Note that the fine surface finish extends on the flat to the end of the pin to a very sharp edge, and then continues down the OD, presenting a superior wire bond finish on all cut surfaces.

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