Positronic®

AMERICAS tel: +1 417 866 2322 • info@connectpositronic.com
ASIA/PACIFIC tel: +65 6842 1419 • singapore@connectpositronic.com
EUROPE tel: +33 5 6263 7442 • contact@connectpositronic.com

For more informaiton visit: www.connectpositronic.com/locations

Absence of Plating at the Bottom of a Deep Recess

OVERVIEW

Barrel electroplating is a process in which the parts to be plated are immersed in a plating solution while suspended in a cylinder (barrel) that rotates. This barrel circulates the parts in the plating solution to ensure consistent coverage from part to part. However, if the part geometry contains a deep recess, an unplated or partially plated surface can occur in those recesses. This happens commonly with screw machined, socket contacts used in electronic connectors.

PROCESSING

The process of electroplating requires that a continuous supply of fresh solution be in contact with the surface being plated. The word ‘fresh’ implies a plating solution that has not been depleted of the plating metal. If the solution is stagnant in the vicinity of the part being plated, it will become depleted of metal as the metal ions plate-out of the solution and onto the part itself. At this point, further buildup of plating metal onto the part will cease until ‘fresh’ solution is moved in to replace the depleted solution. Thus, two of the most critical objectives in electroplating are: 1) Ensuring physical contact between the plating solution and the part being plated; and 2) Achieving continuous replenishment of the depleted plating solution to the area being plated. Because of the deep recess in the socket contact, both of these objectives are difficult, and sometimes impossible, to achieve.

PROCESS LIMITATIONS

When parts are immersed in plating solution, the hole in the contact is filled with air. Because of the fact that the hole is sometimes very deep relative to its diameter, air can be trapped in the hole as a result of surface tension effects. Said differently, a pocket of air can get trapped in the socket recess preventing the plating solution from reaching the bottom of the hole, which yields an area of unplated surface.

Even if the hole fills with plating solution, there is still the problem of it not circulating near the bottom of the recess. Because of this lack of circulation, the solution becomes depleted quickly. Where possible, Positronic incorporates a drain hole near the bottom of deep recesses. A drain hole is a small hole drilled perpendicular to the socket or crimp barrel of the contact. Its purpose is to allow a path for air to escape during the barrel plating process. This feature improves the circulation of the plating solution, therefore reducing the possibility of air being trapped in the recess, but it does not completely eliminate the problem. Generally speaking, the problem worsens as the recess deepens relative to the part’s diameter.

The unplated portion of the socket may appear very dark, possibly with a blue-green or purple tint. Customers often mistakenly conclude that the dark color at the bottom of the hole is contamination and/or corrosion. It is very important to understand that these dark holes may not be contaminated or corroded at all. The dark appearance may be due to the fact that the light from the microscope is not being reflected by a shiny gold surface. It is also important to understand that the portion of the contact used to make a secure electrical connection **is** plated with the proper thickness of gold, nickel (in most cases) and copper. The unplated recess is not involved in the electrical contact path and should not be regarded as a significant surface. Lack of plating in this area would not impair the integrity of the electrical connection.

ASTM B 488 defines a significant surface as one that is normally visible or essential to the function of the article (3.2.1). It also mentions that the inspection criteria may be relaxed to allow for such defects, especially if they are outside or on the periphery of the significant surfaces (7.6.1).

TESTING

In order to verify that these areas of incomplete plating at the bottom of socket contact recesses do not significantly impact the form, fit, function, reliability or service life of the connector, electrical and mechanical performance testing was conducted on five (5) connectors, which were assembled with typical production contacts. After the preliminary testing was performed, the connectors were subjected to 48-hour salt spray exposure then retested for electrical and mechanical performance. The contacts used in the test were closed entry, female contacts with a depth to diameter ratio of 5.15:1 (nominal).

TEST SUMMARY & RESULTS

The connectors were examined visually at 10X magnification and finish characteristic observations were recorded for the area of interest.

The connectors were subjected to dielectric withstanding voltage testing between adjacent contacts and between the contacts and connector body. This test was done in accordance with MIL-DTL-28748 para. 4.7.5 (EIA-364-20). The connectors met the requirements dictated by MIL-DTL-28748 3.5.3, Table III.

The connectors were then subjected to contact resistance testing in accordance with MIL-DTL-28748 para. 4.7.14. All contacts met the requirement dictated by MIL-DTL-28748 3.5.12, Table V.

The connectors were then subjected to insertion and withdrawal force testing in accordance with MIL-DTL-28748 para. 4.7.12. All assemblies met the requirements dictated by MIL-DTL-28748 3.5.10.

The connectors were then exposed to salt fog for 48 hours in accordance with MIL-DTL-28748 para. 4.7.15 (EIA-364-26 condition B). Exterior surfaces were washed with tap water and dried for four (4) hours in a circulating air oven at 38°C. No corrosion was detected sufficient to interfere with mating or unmating the connectors as required by MIL-DTL-28748 3.5.13.1.

The connectors were again subjected to the dielectric withstanding voltage test per MIL-DTL-28748 para. 4.7.5 (EIA-364-20). The All connectors met the requirements dictated by MIL-DTL-28748 3.5.3, Table III.

The connectors were again subjected to contact resistance testing in accordance with MIL-DTL-28748 para. 4.7.14. All contacts met the requirement dictated by MIL-DTL-28748 3.5.12, Table V.

The connectors were again subjected to insertion and withdrawal force testing in accordance with MIL-DTL-28748 para. 4.7.12. All assemblies met the requirements dictated by MIL-DTL-28748 3.5.10.

CONCLUSION

The salt fog exposure is a very aggressive, corrosive environment. It is unlikely that typical connector applications will experience conditions as severe as those being simulated in the salt spray apparatus.

The test data supports the notion that connectors with contacts exhibiting discontinuous areas of plating in the non-functional floor area of the contact, meet the electrical and mechanical performance criteria after a 48-hour exposure to the aggressive environmental conditions found in the salt spray apparatus.