

# **AirBorn, Inc.**

## **PRODUCT TECHNICAL BULLETIN – PTB34**

### **ABSENCE OF PLATING AT THE BOTTOM OF DEEP, BLIND HOLES IN SCREW MACHINED SOCKET CONTACTS**

#### **SCOPE:**

This technical bulletin applies generally to AirBorn’s R-Series connectors, and specifically to the socket contacts used in those connectors. Many of AirBorn’s R-Series connectors are qualified to Mil-C-55302, and there are many other customized versions of these connectors which are designed to meet the requirements of Mil-C-55302. These customized connectors are not specifically listed on the Qualified Products List (QPL) because they have special terminations, custom contact patterns, or other physical differences that differentiate them from the specific configurations listed in the Mil-C-55302 slash sheets. However, the “working parts” of the connectors, namely the mating portions of the pin and socket contacts, are identical to those used in the qualified connectors.

#### **PURPOSE:**

Because of the limitations inherent in the process of electroplating, portions of the socket contact often remain unplated or only partially plated. The unplated (or partially plated) area occurs in a non-functional portion of the socket. This technical bulletin is intended to explain the reason that this occurs, and the effect that the lack of plating has on the performance and reliability of the electrical connection.

#### **BACKGROUND:**

The socket contacts used in AirBorn’s R-Series connectors are manufactured using a two piece construction consisting of an outer screw machined sleeve (which AirBorn refers to as a “collet socket”) and an inner stamped and formed 4-finger spring. The sleeve is cylindrical in shape with a deep, blind hole drilled in the mating end. The 4-finger spring is press-fit into the open end of the hole in the cylinder. When mated, the male pin is aligned with the axis of the sleeve, enters the open end of the drilled hole, and makes electrical contact with the fingers of the stamped and formed spring. Because it is press-fit into the hole in the sleeve, the spring makes electrical contact with the inner diameter of the sleeve which completes the electrical conduction path

# AirBorn, Inc.

## PRODUCT TECHNICAL BULLETIN - PTB34

between the plug and receptacle contacts.

Both the sleeve and the spring are “barrel plated” with gold over nickel. Barrel plating is a process in which the parts to be plated are immersed in the plating solution while suspended in a metal “basket” or “barrel” which is rotated in order to circulate the parts in the plating solution to ensure uniform plating from part to part. This process produces very consistent plating on the spring, and on the outside of the sleeve, but the deep, blind hole in the sleeve is a challenge to the electroplating process.

The process of electroplating requires that a continuous supply of “fresh” plating solution be in contact with the surface being plated. “Fresh” implies a plating solution that has not been depleted of the plating metal (in this case either gold or nickel). If the plating solution is stagnant in the vicinity of the part being plated, the solution 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 on 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: ensuring physical contact between the plating solution and the part being plated; and achieving continuous replenishment of the depleted plating solution to the area being plated. Because of the deep, blind hole in the contact sleeve, both of these objectives are difficult, and sometimes impossible to achieve for several reasons.

First, when the parts are first immersed in the liquid plating solution the hole in the sleeve is initially filled with air. Because of the fact that the hole is very deep relative to its diameter, the air can be trapped in the hole in the sleeve as a result of surface tension effects. Anyone who has ever tried to fill a deep container which has a single very small fill hole by immersing the container in water will understand the problem. In effect, a “bubble” of air often gets trapped at the bottom of the hole. This air bubble prevents the plating solution from reaching the bottom of the hole in the sleeve thus making it impossible to plate the bottom of the hole.

The second problem is that even if the bubble somehow manages to escape and the hole fills with plating solution, there is no way for the plating solution to circulate throughout the hole. Because of the lack of circulation, the plating solution becomes depleted before achieving the proper thickness of plating at the bottom of the hole. This is much less of a problem near the open end of the hole where increased circulation is possible. Thus the ID of the hole can be plated properly near the open end, while the bottom of the hole may remain unplated.

When the R-Series socket contacts are examined under a microscope at approximately 30X using a light source with the capability to illuminate the axial hole in the sleeve, the hole will appear

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## PRODUCT TECHNICAL BULLETIN – PTB34

very dark, possibly with a blue-green, or even purple tint if there is no gold plating at bottom of the hole. If even a small amount of gold plating has reached the bottom of the hole, the hole will appear bright, shiny, and gold in color even if the gold is only a few microinches thick. After visual inspection of R-Series connectors, customers often mistakenly conclude that the dark color at the bottom of the hole is contamination and/or corrosion.

However, it is very important to understand that these “dark hole sockets” are not contaminated or corroded. The dark appearance is due only to the fact that the light from the microscope isn’t being reflected by a shiny gold surface at the bottom of the hole. It is also important to understand that the part of the sleeve which is used to make an electrical connection is plated with the proper amount of both gold and nickel (ie. the ID of the sleeve at the top of the hole where the 4-finger, press-fit spring makes contact with the sleeve). The unplated area is not involved in the electrical contact path and is thus a “nonfunctional area”.

### MIL-C-55302 REQUIREMENTS and SUPPLEMENTAL TESTING:

In paragraph 3.3.3.4.3 Mil-C-55302 states: *“nonfunctional areas need not be overplated, provided they have a minimum thickness of 30 microinches of nickel per QQ-N-290 class 2”*. In the strict sense, the R-Series socket sleeve does not meet this requirement because even though the bottom of the hole in the sleeve is a “nonfunctional area” it may not be plated with nickel as required by paragraph 3.3.3.4.3. Because of this, AirBorn has had a considerable amount of supplemental testing performed at an independent test lab which specializes in the testing of electrical connectors. The purpose of this testing was to assure that the unplated area at the bottom of the hole would not have a detrimental effect on the performance or reliability of the contact even in extremely corrosive environments. As a result of this testing, AirBorn was granted a waiver of the plating requirement on March 13, 1997 by the Defense Logistics Agency, Defense Supply Center, Columbus OH. The letter (copy attached) granting the waiver states: *“The testing performed indicates that the absence of plating at the bottom of the contact bore does not effect the performance of the contact. Therefore, the absence of plating in this area will be acceptable provided any corrosion formed as a result of salt spray testing does not migrate into the contact mating area.”* Further testing by the same test lab has confirmed that whatever small amount of corrosion that exists at the bottom of the hole following salt spray testing does not migrate into the contact area. This has been confirmed both by visual examination and by contact resistance measurements.

As part of this test program a group of standard production R-Series contacts and a second group of contacts with completely unplated sleeves were subjected to Mil-C-55302 salt spray test

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conditions. In addition to the salt spray testing, identical contacts were also subjected to environments containing hydrochloric acid, nitric acid, and sulfurous acid vapors. In all cases low level contact resistance measurements made before and after the exposure to the various corrosive atmospheres showed that the contact resistance remained low and stable.

### **SUMMARY and CONCLUSIONS:**

Salt spray testing, per the requirements of Mil-C-55302, conducted by an independent test laboratory has shown that neither the performance nor the reliability of the R-Series socket contact is impaired as a result of a lack of full plating at the bottom of the blind hole in the socket contact sleeve. Additional testing in even more aggressively corrosive environments has further confirmed that any corrosion that may occur at the unplated bottom of the hole does not impair the integrity of the electrical connection. The cognizant military activity, the Defense Logistics Agency, Defense Supply Center in Columbus OH has granted AirBorn a waiver of the nonfunctional area plating requirement in Mil-C-55302 based on this testing. A copy of this letter is attached for reference.

# AirBorn, Inc.

## PRODUCT TECHNICAL BULLETIN – PTB34



DEFENSE LOGISTICS AGENCY  
DEFENSE SUPPLY CENTER, COLUMBUS  
POST OFFICE BOX 3990  
COLUMBUS, OH 43216-5000

IN REPLY  
REFER TO

DSCC-VQP-97-0509 (Mr. Wallace/614-692-7107/rew)

March 13<sup>th</sup>, 1997

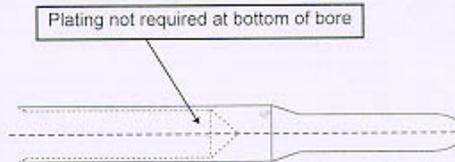
SUBJECT: Absence of Plating in Socket Contacts, MIL-C-55302/190 & /192, FSC 5935  
Preparing Activity - CC

Mr. Joe DeRochers  
Airborn, Inc.  
4321 Airborn Drive  
Addison, TX 75001-0519

Dear Mr. DeRochers:

Please reference your letter of December 31<sup>st</sup>, 1996 and the Contech Research report dated April 8<sup>th</sup>, 1987. The testing performed indicates that the absence of plating at the bottom of the contact bore does not affect the performance of the contact.

Therefore, the absence of plating in this area (see below) will be acceptable, provided any corrosion formed as a result of salt spray testing does not migrate into the contact mating area.



Sincerely,

ROBERT P. EVANS  
Chief  
Passive Devices Team  
Sourcing and Qualifications  
Unit