Solving the Wristband Snap Release Problem

by Gene Bliley, Bliley Consulting LLC

When ESD wristband snaps disconnecting from the coiled ground cords became a persistent problem for one manufacturing line, a thorough investigation revealed the culprit - the stud snap on the buckle. More specifically, a direct correlation was discovered between the breakaway forces and the unintentional disconnects for formed snap vs. machine snaps.

The solution resulted in an improved ESD process as well as a reduction in the cost of wristband and coil-cord products for Lucent Technologies in Columbus, OH. In this 2.2 million square feet facility, approximately 5,200 employees are engaged in manufacturing wireless telecommunication equipment deployed throughout the world. An estimated 3,000 ESD-protected workstations are located in 39 separate manufacturing areas.

All employees are trained in ESD control per Lucent corporate requirements. Each employee is recertified at a maximum of 24 months. Control of ESD is accomplished through wrist straps, static-dissipative work surfaces, grounded workstations, and control of static-generating material.

The Problem Unfolds

In April of 1999, a high-performance team on second shift asked the ESD coordinator to help solve a functionality problem with wristbands. The team reported that the coiled ground cord was easily disconnected from the wristband. The accidental snap release was sometimes discovered immediately but more often, several minutes later.

This problem puzzled the ESD coordinator who had been in his position for nearly four years. Why had this problem not surfaced earlier? After a couple of meetings with the team, the ESD coordinator decided that the concern was valid and started an investigation to determine the magnitude of the problem.

Analysis

Production associates began keeping records on the frequency of accidental snap releases over a given period of time. Each of the 16 associates recorded the number of unintentional disconnects over a 21-day period. During the study period, 241 unintentional disconnects were experienced by the team members. This data yielded an average of 0.72 releases per person per day and substantiated the magnitude of the problem.

Since four employees had zero disconnects, analysis of their work patterns was conducted to determine if undue stretching of the cord and/or excessive mobility might be responsible for the accidental releases. This study revealed that employees seated at test sets had the fewest releases.

A dimensional analysis was conducted to determine if the stud on the wristband might be the problem. The shank, minimum diameter, and the head, maximum diameter were measured and the data analyzed. In many cases, the analysis noted that the difference between the two diameters was only a few thousandths of an inch. This finding convinced the ESD coordinator that a real problem existed and further investigation was warranted.

The supplier of the ground cords and wristbands was contacted to discuss the breakaway force specification. The supplier maintained that its breakaway force specification ranged between 0.5 and 5.0 pounds.

This specification was compared to ESD Association standard ESD-S1.1 Standard for Protection of Electrostatic Discharge Sensitive Items: Personnel Grounding Wrist Straps. It states that “at least 1 pound but not more than 5 pounds of breakaway force applied to the ground lead in the normal disconnect direction shall be required to cause separation”.

The supplier was asked to provide breakaway force data on a sample of wristbands and ground cords from recent production. **Figure 1** is a line chart of that data.

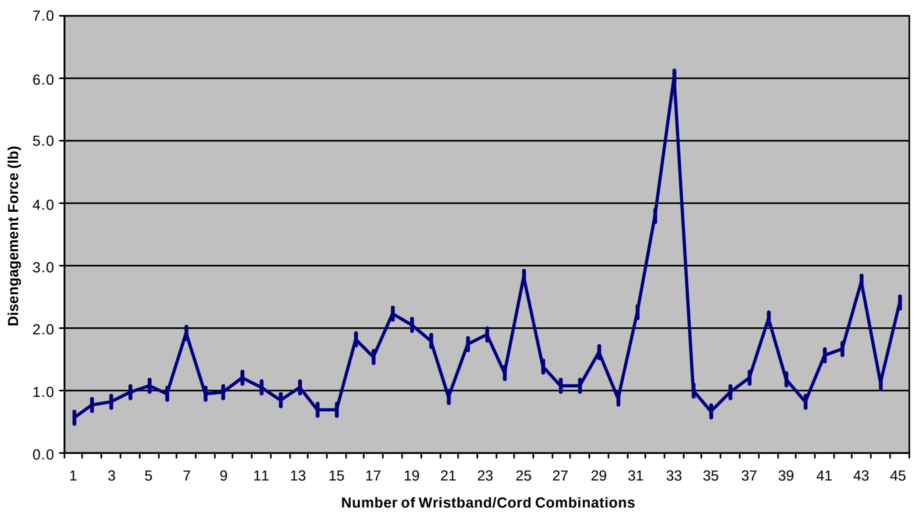

Figure 1. Breakaway Force Data for Wristbands with Formed Snaps

Analysis of the data showed that one-third, 15 of 45 band/cord combinations have a breakaway force less than 1.0 lb. The average breakaway force is 1.52 lb, and the standard deviation of the sample is 0.96 lb.

Another supplier suggested that an alternate wristband be evaluated. The supplier hypothesized that a wristband with a machined stud would provide the dimensional properties necessary not only meet the ESD-S1.1, but also to alleviate a large portion of the unintentional disconnects. The new supplier provided the breakaway force data on sample bands with machined snaps, which appears in **Figure 2**.

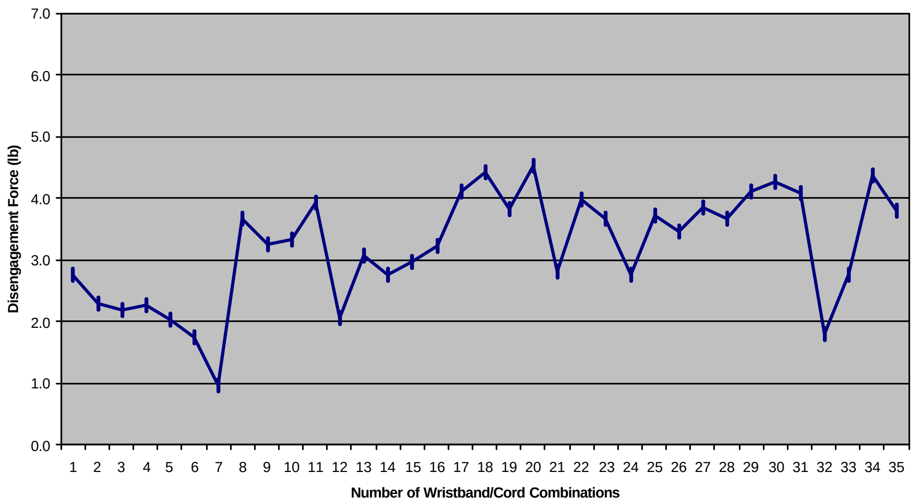

Figure 2. Breakaway Force Data for Wristbands with Machined Snaps

Analysis of the data for wristbands with machined snaps showed an average of 3.22 lb breakaway force and a standard deviation of 0.30 lb. Only one band/cord combination had a breakaway force of less than that prescribed in ESD-S1.1.

Further analysis was conducted in an attempt to explain the difference in breakaway force data between formed snaps (the snaps currently in use) and the machined snaps with an average approximately twice as high.

Formed snaps are fabricated by a stamping operation of the two pieces that will eventually become the assembled snap. Machined snaps are exactly what the name implies. They are machined on automated equipment from stainless steel rod stock. A sample of each snap was mounted, cross-sectioned, and lapped for analysis.

Figure 3 illustrates a cross section of the two pieces of a formed snap after assembly onto a wristband. The riveting operation produced significant distortion of the snap head and body. This profile is responsible for the lower breakaway force distribution shown in Figure 1.

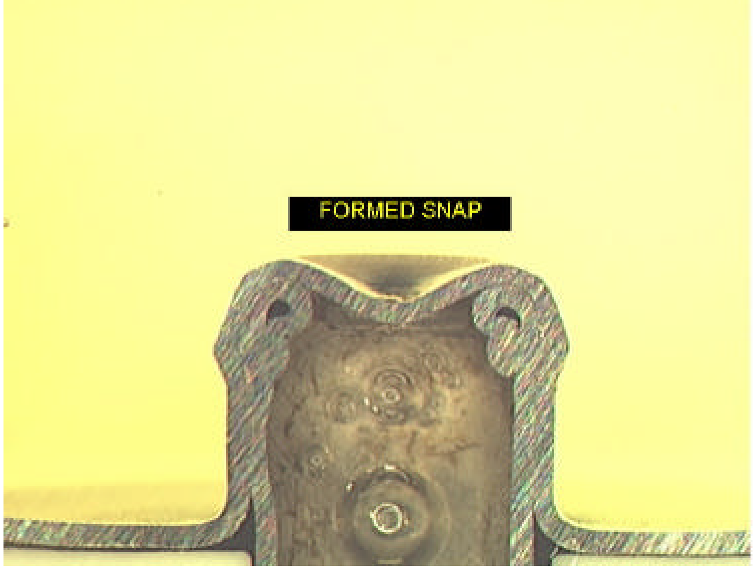

Figure 3. Cross Section of a Formed Snap

Figure 4 is the cross section of a machined snap. Because of the solid construction and precise machining, it appears completely different than the formed snap and explains the corresponding difference in the breakaway force distributions.

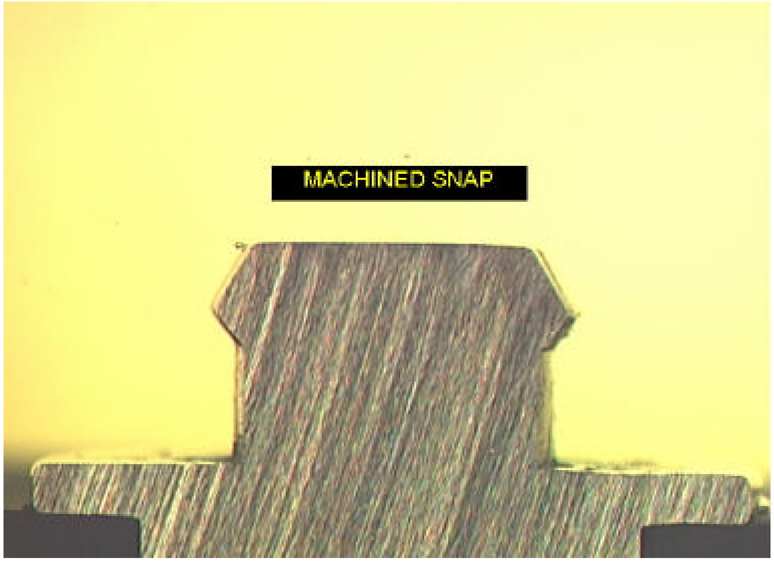

Figure 4. Cross Section of a Machined Snap

The ESD coordinator was convinced that the machined snaps were superior. He purchased new wristbands for each second-shift team member and conducted another evaluation. Employees were allowed to retain their standard ground cords. As before, each person was asked to record all accidental snap releases for the study period.

Results

During the 28-day evaluation period, a total of 31 unintentional disconnects was experienced by 15 participants. This yields an average of 0.07 releases per person per day and represents an order of magnitude improvement; however, a complete solution to the problem had not been found. Further investigation was necessary to determine if the disconnects were the result of using the standard ground cord with the new wristbands.

Ground cords from the same manufacturer that supplied the machine-snap wristbands were purchased and a third factory test was conducted for a study period of 32 days. During his time, using machine-snap wristbands and ground cords by the same supplier, there we no accidental releases. The team was convinced that a complete solution to the problem had been realized. Purchasing requirements were changed to specify wristbands with machined snaps and the new high-reliability ground cords.

Conclusion

The ESD program manager learned that employee input is crucial to continuously improve the process. He had nearly dismissed their claims that unintentional disconnects were a problem. Together the team learned that the problem was much larger than just one department on second shift.

As improvements were forthcoming, many employees indicated that they had experienced the same problem. Some employees said they had tied a loop with the ground cord around the wristband to provide a strain relief.

Not only was the ESD process improved, but the wristbands with machined snaps and the high-reliability ground cords also were less expensive then the formed-snap products previously used.

Recommendation to ESD Coordinators

- Listen honestly to your team members, take their complaints seriously, and strive to create an atmosphere where people feel comfortable bringing information forward.
- Be willing to reevaluate previously approved items and seek out best-in-class products.
- Realize that ESD programs are continuous improvement processes, and not a one-time event that is established and forgotten.
- Partner with suppliers and share your concerns and problems with them. They can help identify the reality of problems and suggest possible solutions.

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About the Author

Gene Bliley *is a member of the ESD Association and offers ESD engineering consultation, factory assessments, and training to the manufacturing community. Previously, he managed the ESD control program at the Lucent Technologies facility in Columbus, OH. While there, Mr. Bliley was a member of the Lucent Global Leadership Team Steering Committee; co-chairman of the corporate ESD Control Subcommittee, and a member of the Lucent ESD Task Group. Bliley Consulting, 614-939-0184, e-mail: ebliley@blileyconsulting.com.*

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