

**Packaging for Telecommunications Systems and Assemblies: Does it Provide Adequate Protection for Electrostatic Discharge Sensitive (ESDS) Electronics?**

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- **Introduction**-Early in 1992 the Bell Operating Companies - Bellcore ESD Team published an ESD packaging wish list <sup>[1]</sup>. This list contained thirteen features or characteristics thought necessary to protect circuit-packs, (also called plug-ins or circuit card assemblies) from ESD degradation or mechanical damage. Eight of these were named as high priority items. These were: Closed container, Scan-ability, Transparency, Flame Retardant, Stackability, Mail-ability, Reusability, and Recycle-ability. Since this list was published, many of these items were discussed at great lengths. A unique packaging seminar took place in April 1995 at a Bellcore Generic Requirements Early Industry Interaction held at Bellcore TEC in Lisle, IL. The meeting attracted Bell Operating Company ESD Team Experts, Telecommunication Equipment Suppliers, Packaging Manufacturers, and ESD Testing and Certification Companies. This was an unusual meeting because the forty attendees were given opportunity to voice their ESD packaging concerns in public. Many of the conclusions of this forum were used as a basis for the reissue of Bellcore GR-1421-CORE <sup>[2]</sup>. The following is an abbreviated discussion of some hot topics raised at this meeting and other packaging concerns.
- **Is a totally enclosed container really required?** Totally enclosed containers for Electrostatic Discharge Sensitive (ESDS) circuit card assemblies are necessary for three reasons: First, to protect them from direct contact ESDs; second, to provide physical protection; and third, to protect the circuitry from outside contamination. Open-ended corrugated sleeves are not sufficient. Containers should have an inner and outer surface that is static dissipative to prevent triboelectric charging of the container and assembly. The static dissipative properties of the container should remain active in dry climates (12% RH) for long periods of time. Some plastic clamshells and bags do not meet this requirement.
- **Should a package be sealed?** Containers should have a tamper proof seal so that the user has some guarantee the contents will function. An unsealed package has an uncertain history. It could be a good repaired assembly or a defective one. The contents of an unsealed container may have been handled by personnel who did not use ESD protection. The circuit

cards may be contaminated or have sustained physical damage. Often containers are opened by ESD untrained storeroom personnel to check to see if the outside symbols on the package match the product inside. This is a controversial practice. No package should be opened by anyone without ESD control training. Packages must be resealed with a new seal indicating that the storeroom personnel or technicians have opened them.

- **Can circuit pack bar-codes be scanned reliably through a transparent window or package?** Bar codes were not designed to be scanned through a transparent medium <sup>[3]</sup>. The original wand type Light-Emitting Diode (LED) scanners were meant to be used in contact to the bar code over-laminate. As scanners improved, some would work when scanned in proximity to the bar code, but not through a window. With the introduction of newer type laser scanners, it was found that some scanners read the bar code through a plastic package in 1 to 3 seconds about 89 to 93% of the time<sup>[4]</sup>. However, one scanner took 25 seconds. The real question is not can bar codes be decoded through a window, but can they be read according to a specified ANSI grade <sup>[5]</sup> The Bellcore standard is an academic “C” grade for a specified wavelength and aperture number to read a code 39 symbol.<sup>[6]</sup> Reading the small code 39 symbols can be difficult because of the minimum spacing of 0.010 inch. However, this grade guarantees that the bar code will be read correctly 100% of the time. The ANSI bar code grading system consists of four parameters. They are decodability, contrast, modulation and defects. It was found that 80% of the plastic clamshell packages tested failed modulation or defects, and consequently the “C” grade of the ANSI guidelines <sup>[4]</sup>. Improvements are needed in the light transmission properties of the plastic package.
- **How important is flammability?** Packaging flammability is important to the telecommunication companies whenever packaged circuit cards are not stored in closed metal cabinets or separate areas away from active equipment.
- **What about over-packs for shipping individual containers?** Over-packs may be necessary to ship individual plastic containers for shielding and security reasons, or because some plastic containers are not rugged enough to withstand shipment in the mail.
- **What are the real issues in recycle-ability?** The issue of recycle-ability mostly involves the laminating of different materials. Some of the problems originate from the use of paper labels on a plastic packages or the use of plastic windows for corrugated packaging. In the

case of plastic containers with paper labels, the removal of the adhesive may be difficult and costly. This problem could be solved by using plastic labels or designing the plastic container with a slot for a non-adhesive label. In the case of corrugated containers, openings for windows can be fabricated that do not require an adhesive to hold the window in place.

- **Should packaging be static shielding?** The equipment supplier is supposed to know. But, sometimes users wonder when non-electronic parts come shipped in static shielding bags. How do suppliers decide? Users do not usually know how sensitive a bare circuit pack may be to ESD when exposed to a changing electric field. The reissued version of Bellcore's GR-78-CORE <sup>[7]</sup>, will requires suppliers to test the sensitivity of circuit card assemblies to a less severe version IEC-61000-4-2 <sup>[8]</sup> In the future this may be a part of users' contracts. Until then, users must assume all electronics packaged in static shielding containers are sensitive to varying electric fields and use the necessary ESD precautions. The supplier needs to identify the most cost effective packaging with the best shielding properties. Both corrugated and bag type packaging can be designed with adequate shielding inner layers. The plastic container relies on the air space on the inside of the package for attenuating the ESD Event. Some packaging engineers argue that this distance can never be enough.
- **Which is the package of choice: The corrugated container or plastic clamshell?** In some cases plastic containers are obviously not rugged enough to package very heavy bulky electronics. In other cases either plastic clamshells or corrugated boxes can be used. Plastic containers may be cheaper than their corrugated equivalents, but is packaging cost an issue for a \$1000 plus circuit card? Some end users insist on being able to see the contents of containers, however others do not care or are concerned about security during shipping and do want to expose the contents. Plastic or corrugated containers with windows that have transparency capable of reliable bar code scanning will reduce circuit card handling by personnel. A corrugated container, because of its ruggedness, may have more reuse cycles. An all plastic container may be easier to recycle.
- **What are the future packaging requirements?** Packaging surveys done within the Bell Operating Companies showed that half of the current ESD packaging fails a three-parameter test consisting of: Is the package totally enclosed? Does the surface resistivity fall in the static dissipative range? Does the package have an ESD warning label? This survey is of serious concern to users. It demonstrates that some engineers do not specify static control

packaging that meets current industry guidelines, and that some packaging is being sold to equipment suppliers who assume that it meets ESD requirements without testing it <sup>[9]</sup>. In the past Telecommunication company procurement organizations told me that equipment contracts will include GR-1421-CORE requirements for packaging. They have stated that they are willing to pay for packaging quality, reliability, recycle-ability and reusability. However, with the introduction of ANSI/ESD S20.20, both users and suppliers may switch to using this document to specify packaging in addition or instead of GR 1421-CORE.

#### **References:**

1. *Bell Companies Wish List to Shape ESD Packaging*, EOS/ESD News Item, from Art Varga, Ameritech Services, EOS/ESD Technology, February/March 1992, p2.
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3. Private communication with A. Gilligan, AT&T, developer of the bar code.
4. Bellcore and Applied Image, Inc. from a study funded by Bell Atlantic (Now Verizon).
5. *American National Standard for Information Systems-Bar Code Print Quality-Guideline*, ANSI X3.182-1990, American National Standards Institute, 1430 Broadway, New York, NY 10018.
6. Bellcore, TR-ST5-000383, Issue 5, January 1991, *Generic Requirements for Common Language ®, Bar Code Labels*, Figure 4.
7. GR-78-CORE, 1997, *Physical Design Requirements*, is available for \$430.00, paper or CD-ROM, from Telcordia Technology's Homepage on the Internet at <http://telecom-info.telcordia.com/site-cgi/ido/index.html>
8. International standard IEC-61000-4-2, 1995, (was IEC-801-2, 1991)-*Electromagnetic compatibility (EMC) - Part 4- Testing and measurement techniques - Section 2: Electrostatic discharge immunity test*.
9. ANSI/ESD S20.20, *ESD Association Standard for the Development of an Electrostatic Discharge Control Program for - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)* ESD Association, 7902 Turin Road, Suite 4, Rome, NY 13440-2069.

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