Testing Your ESD Knowledge

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As technology continues to miniaturize micro-electronic products, circuits and sub-assemblies may become increasing susceptible to damage from Electrostatic Discharge (ESD). State of the art semiconductor devices may be destroyed or damaged by Human Body Model (HBM) and Charged Device Model (CDM) discharges of 100 volts or less. And as little as 10 volts may damage today's disk drives.

To protect the quality and reliability of these increasing sensitive products, ESD programs may require improvement. Complete understanding of the sensitivity of the devices being handled and the capabilities of the ESD program must be analyzed. ESD programs that were developed five to ten years ago, when device sensitivity was approximately 1000 volts, are no longer adequate for some of today's semiconductors and woefully inadequate for disk drives.

A detailed self-assessment survey has been developed to ascertain the capabilities of existing programs and identify possible deficiencies. This article presents a modified, mini-version of that survey to test the ESD knowledge of engineers and managers. Even experienced ESD program managers may be surprised by their score. Ten questions (phrased in True or False format) make scoring to a 100% scale easy. It is recommended that each question be thoughtfully and honestly answered and your response to each question recorded. Later in the article, each question will be answered and a complete explanation given. Refer to **Figure 1**, relax and enjoy testing your ESD knowledge.

ESD Quiz	True	False
1) HBM is the dominant ESD failure mode in today's manufacturing environment?	☐	☐
2) All necessary insulators should be connected to the ESD work station's common point ground to remove any charge on them?	☐	☐
3) Management commitment is vital to the success of an ESD program?	☐	☐
4) The primary cause of ESD failures associated with automated equipment is CDM?	☐	☐
5) It is possible for a robust ESD program to reach a point of limited return on investment?	☐	☐
6) ESD sensitive components and assemblies can be damaged even though an operator is properly grounded?	☐	☐
7) ANSI/ESD S20.20 is rapidly becoming the industry standard for handling static sensitive products?	☐	☐

8) An auditing program is essential to a successfully managed ESD program?	☐	☐
9) A corrective and preventive action program adds needless cost to an ESD program?	☐	☐
10) Once an ESD sensitive component is installed on a circuit board, it is immune from ESD damage?	☐	☐

Figure 1

We hope that you found the questions interesting. In the following paragraphs, we will provide the correct answer and discussion for each question.

Answers and explanations

1) HBM is the dominant ESD failure mode in today's manufacturing environment. The correct answer to this question is **false**.

Charged Device Model (CDM) is the dominant failure mode in todays manufacturing environment because it is almost impossible to prevent components and assemblies from becoming charged. This is especially true due to the prevalence of high-throughput automated assembly and test equipment used in most factories. Thus, it is critically important to collect CDM data on Electrostatic Discharge Sensitive (ESDS) devices and compare these thresholds with an ESD program's designed-in level of protection.

2) All necessary insulators should be connected to the ESD work station's common point ground to remove any charge on them? The correct answer to this question is **false**.

Grounding will not remove a charge on an insulator because insulators (by definition) are poor conductors of electricity. This is where the term static charge comes from. When an insulator becomes charged, the charge may persist for a long period of time. For this reason, all unnecessary static generating materials must be removed from the top surface of the work position when ESD sensitive items are present. Essential insulators may remain at the work position but should be located toward the rear of the station and never allowed to come into direct contact with ESDS items.

3) Management commitment is vital to the success of an ESD program? The correct answer to Question 3 is **true**.

Since controlling ESD transcends an entire company, its suppliers, and subcontractors, it is critically important to have support from all levels of management, especially from the top levels. This allows a coordinated effort to swiftly and efficiently implement the details of the plan. Without this coordinated support, the numerous roadblocks that develop along the way will become insurmountable and the program will fail.

4) The primary cause of ESD failures associated with automated equipment is CDM? The correct answer to Question 4 is **true**.

A buildup of charge on either a device or a mechanism is inevitable with the repetitious movement of automated machine parts in contact with devices or printed wiring board assemblies. The high degree of charge associated with highly conductive mechanisms are the ideal condition for a rapid discharge of energy that can either damage or destroy devices by means of the charged-device model. Most plants have the typical ESD control protection, such a wrist straps, grounded mats, ionizers, etc., but no provisions to prevent machine-caused damage.

5) It is possible for a robust ESD program to reach a point of limited return on investment? The correct answer to Question 5 is **true**.

The strategic and economic benefits of an ESD program far outweigh the associated implementation expenses. As compliance with a sound ESD design and manufacturing practices improves, a corresponding return on investment develops, typically up to 1000%. It is possible; however, for a robust ESD program to reach a point of limited return on investment. At this point, the line between necessary insurance and costly overkill has been crossed. Economic gains are maximized when implementation costs are controlled and unnecessary costs are avoided.

6) ESD sensitive components and assemblies can be damaged even though an operator is properly grounded? The correct answer to Question 6 is **true**.

A CDM event can easily damage charged components and assemblies at a fully operational ESD workstation. This damage can occur in a number of ways. For instance, static generators are often prevalent in a manufacturing environment, and the charge on a static generator cannot be removed by grounding. Sensitive items that are grounded while in the presence of the electrostatic field will be subject to a CDM event even in the hands of a grounded operator.

7) ANSI/ESD S20.20 is rapidly becoming the industry standard for handling static sensitive products? The correct answer to Question 7 is **true**.

Prior to ANSI/ESD S20.20, there was no global standard for managing ESD within manufacturing facilities. Issued in 1999, S20.20 was developed by the ESD Association in response to a request from the United States Department of Defense to prepare an ESD process standard to replace MIL-STD 1686. The ANSI/ESD S20.20 standard provides a formal, consistent process for OEMs, suppliers, and contractors.

8) An auditing program is essential to a successfully managed ESD program? The correct answer to Question 8 is **true**.

Auditing is the binding force behind a sound program and is essential to the program's long-term success. Periodic audits promote compliance and a strong management commitment that fosters continuous improvement. Published reports can motivate managers and engineers to improve compliance in their department. They provide the process owner with the necessary information to effectively manage and improve the ESD program.

9) A corrective and preventive action program adds needless cost to an ESD program? The correct answer to Question 9 is **false**.

Regular assessment of an ESD program's critical factors, including the analysis of audit data, sets the entire program on course. But without an effective corrective and preventive action program, continuous improvement will not result. Many companies, failing to recognize the importance of this, have undertaken control programs with enthusiasm only to let them deteriorate into a state of despair and total ineffectiveness.

10) Once an ESD sensitive component is installed on a circuit board, it is immune from ESD damage? The correct answer to Question 10 is **false**.

This is a common ESD myth. Actually, the failure rate and sensitivity of a component can increase after it is inserted into a PWB assembly because the device's junctions may become more accessible through the conductor paths of the circuit board. ESD controls are just as important for circuit boards assemblies as they are for individual components.

Scoring

If you're interested in scoring your ESD Knowledge Quiz, simply assign ten percentage points for each correct response. Hopefully, you have scored highly and have an excellent understanding of controlling ESD in your facility.

Summary

In summary, let's further discuss four areas that seem to be the least understood and are often seen during ESD audits of manufacturing facilities.

Charged Device Model (CDM)

> A CDM, ESD event occurs when a device becomes charged due to some manufacturing or handling process and is subsequently grounded to a highly conductive surface. Rise and fall times of CDM events are typically less than one nanosecond. CDM discharges are mitigated by eliminating charge buildup on ESDS items by controlling insulators and using static dissipative materials where appropriate.

Control of static generating material

> Static generating materials are one of the most frequent observations during ESD audits. Insulators are generally static generators. Examples of common static generating materials, typically found at ESD-safe workstations, include plastic bottles and tool boxes, packaging materials, radios and CD players, lunch totes, Styrofoam and Plexiglas.

Control of static generating material (continued)

Adopt the following rules to effective manage insulators:

1) Do not allow unnecessary static generating materials to be brought into the ESD protected area.
2) Essential insulators may reside at the work position but should be located toward the rear of the station and never allowed to come into direct contact with ESDS items.
3) Consider the deployment of ionizers where appropriate

Components on circuit boards are still susceptible to ESD damage.

Many individuals believe that once an ESDS device is installed onto a circuit board that it is no longer at risk. This is a common ESD myth. ESD controls are just as important for circuit boards assemblies as they are for individual components.

Auditing and preventive action programs

Auditing is the binding force behind a sound program and is essential to the program's long-term success. But without an effective corrective and preventive action program, continuous improvement will not result. Many companies, failing to recognize the importance of this, have undertaken control programs with enthusiasm only to let them deteriorate into a state of despair and total ineffectiveness.

About the Author

Gene Bliley *is the President of Bliley Consulting (www.blileyconsulting.com), and offers ESD engineering consultation, on-site audits, and ESD training to the manufacturing community.*

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