

DESCO EUROPE

ESD CONTROL SURVEY - REPORT

Survey at: Test Company
Letchworth
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United Kingdom
For: Gary Mansell

Survey Date: 2016-01-11
Report Date: 2016-01-12

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SUMMARY

Test Company Letchworth has made a strong commitment to improve the overall quality of their ESD Control Programme. An important component to an effective and consistent Programme is management support and the establishment of an ESD committee, with representation from all departments within an End-User organisation. An effective ESD Control Programme can only be achieved and maintained if there is complete buy-in from the entire organisation. An effective ESD committee will help to address and deal with existing and new ESD concerns as the needs of the organisation change.

Test Company has taken important positive steps in the process by developing a comprehensive Programme, implementing and enforcing it. Further improvements will optimise the Programme and fully comply with IEC 61340-5-1 minimum recommendations and acceptable industry practices. Gary Mansell and Test Company are congratulated on their commitment to improve overall quality, productivity and customer satisfaction.

PURPOSE

Thank you for providing Desco Europe the opportunity to assist in the evaluation of your ESD Programme. Over more than twenty years, Desco Europe has developed a reputation for providing valuable quality products and technical assistance to help improve your quality, productivity and customer satisfaction. As your partner in optimising your ESD Programme, our goal is to turn ESD Control into a competitive advantage for you.

An ESD survey was performed to accomplish the following:

1. Assess the current level of the ESD Control Programme.
2. Identify appropriate ESD protective products or improved methods to satisfy IEC 61340-5-1 and upcoming audits.
3. Make suggestions on how to improve Test Company Letchworth's ESD Control Programme in general.

Desco Europe primarily uses IEC 61340-5-1 and its User Guide IEC 61340-5-2 as the basis for performing ESD Surveys. The general title of IEC 61340 is Electrostatics. Part 5 1 is "Protection of electronic devices from electrostatic phenomena General requirements". Part 5 2 is "Protection of electronic devices from electrostatic phenomena User guide". IEC 61340-5-1 and this User Guide are aimed purely at electronics. It states "Where no ESD handling precautions are taken, a high proportion of electronic apparatus failure can be attributed to ESD damage. This figure could in theory be reduced to zero by adopting the precautions described in IEC 61340-5-1 in all areas."

Per IEC 61340-5-2 paragraph 1.1 "This technical specification is intended to cater for electronic components, assemblies and subassemblies with a sensitivity of 100 V or greater (human body model (HBM), and as such covers most items available. There are on the market a few items which may suffer damage at lower levels. Where these are used, additional or alternative methods should be used. The HBM has been chosen as the major criteria, as damage from human contact is still the most common source even in today's automated society."

INTRODUCTION

Some of the effects of static electricity have been known for several thousands of years. In more recent times, their properties have been understood and have been used to their advantage in many applications. Unfortunately some properties of static electricity cause problems, particularly in the electronics industry. Many electronic components and assemblies used in high technology products can be damaged or degraded by the sudden exchange of static electrical charges. This release of stored energy is called ElectroStatic Discharge or is most commonly referred to as ESD. Components that have a susceptibility to damage from electrostatic discharge are called ESD Sensitive or ESDS. These include transistors, diodes, laser diodes, electro-optical devices, precision film resistors, capacitors and an ever-increasing variety of integrated circuits. Susceptibility of devices to ESD is increasing with the drive to miniaturise electronic devices and increase operating speeds. Devices are subject to ESD damage at every stage of production from wafer fabrication to a populated circuit board assembly.

The most common electrostatic generator is triboelectric charging. This is caused when two materials come into contact or are rubbed together and then separated. Such actions allow electrons to move from one surface to another, creating a charge imbalance between the materials. Common sources of ESD include personnel, items made from common polymeric materials and processing equipment. ESD can damage parts by direct contact with a charged source or by electric fields emanating from charged objects that induce a charge on grounded sensitive items.

PREREQUISITE

A particular written ESD Control Plan should be based on the device and item susceptibility or voltage sensitivity of the most sensitive components used in the facility. Examples of ESDS parts are microcircuits, discrete semiconductors, thick and thin film resistors, hybrid devices and piezoelectric crystals.

A prerequisite of ESD control is the accurate and consistent identification of ESD sensitive items. When the voltage sensitivity of your most sensitive device is not known, we will assume a 100 volt human body model sensitivity level.

FUNDAMENTAL ESD CONTROL PRINCIPLES

The fundamental ESD control principles are:

- All conductors, including personnel, must be electrically connected and attached to a known ground. This attachment creates an equipotential balance between all items and personnel. Electrostatic protection can be maintained at a potential above a "zero" voltage ground potential as all items in the system are at the same potential.
- Ionization systems provide neutralization of charges on process necessary insulators and isolated conductors.
- Packaging of ESD sensitive items outside an ESD Protected Area should limit tribo electric charging, provide shielding against electrostatic and discharges, and be capable of providing charge drainage to EPA ground when brought into an EPA. All non ESDS items brought into an Protected Area shall be packed in low charging, dissipative ESD packaging.

PERSONNEL SAFETY

- The ESD Control Programme can in no way replace or supersede any requirements for personnel safety.
- Ground fault circuit interrupters (GFCI) and other safety protection should be considered wherever personnel might come into contact with electrical sources.

ESD CONTROL PROGRAMME

- Per IEC 61340 5 2 ESD damage is very real, but as much of the damage takes place below the levels where the human senses can detect discharge, the awareness factor is vital. Training is one of the best means of achieving this awareness and should be included as an essential part of any structured handling procedure.
- A written ESD Control Plan should establish, document, implement, maintain and verify the compliance of the Programme in accordance with the requirements of IEC 61340-5-1.
- The ESD Control Plan should provide for electrostatic control and protection during design, production, inspection, test, storage, shipment, installation, use, maintenance, replacement and repair functions.
- Tailoring is acceptable and requirements may be added, modified or deleted. Tailoring decisions, including rationale, should be documented in the ESD Control Programme Plan.
- The ESD Control Plan should cover training, compliance verification, technical requirements and should include a listing of the specific type of ESD protective materials and equipment used in the programme.
- The ESD Control Plan should ensure that suppliers of ESD sensitive components and assemblies have established and implemented a Programme in accordance IEC 61340-5-1.

TRAINING PLAN REQUIREMENT

- Initial and recurrent ESD awareness and prevention training shall be provided to all personnel extending beyond the employees who actually handle ESDS, designers, associated supervisors and managers. It should include personnel in purchasing and planning roles.
- The training shall include an objective evaluation technique to ensure comprehension and adequacy. It is the responsibility of the ESD Co Ordinator to be satisfied that the level, quality and style are adequate, to set the intervals for refresher training and to ensure that re-training within the specified interval is carried out. A register of trained personnel should be maintained.

COMPLIANCE VERIFICATION PLAN REQUIREMENT

- A Compliance Verification Plan should be established and audits be conducted.
- Subclause 10.1 of IEC 61340 5 1 calls for periodic audits and intervals of not more than 12 months between these audits are recommended. Additionally, random audits should be held so that precautions are not tightened up periodically when audits are expected.
- Test equipment shall be selected to make measurements of appropriate properties of the technical requirements that are incorporated into the the ESD programme plan.
- See IEC 61340-5-1 Table 3 – Example of audit report.

Questionnaire

Questions	Y	N	Customer's Comments	Our Observations and Measurements
Do you have a written ESD Control Plan?	Y			We reviewed the programme briefly and it looked to be very detailed.
Do you have a QPL (Qualified Parts List) – List of approved ESD protective products		N	No but they are looking to impliment one as they are finding some items are being purchased without prior thought into whether they need to be ESD safe	It is a recommendation but not currently a requirement of EN 61340-5-1.
Do you have a Compliance Verification Plan?	Y		Included in their ESD Control Plan is a schedule for testing wrist straps, footwear, benches and flooring.	This is in compliance with EN 61340-5-1.
Do you have a training plan?	Y		Personnel who work with ESDS items are trained on their procedure when they start and personnel have to take a test each year.	This is in compliance with EN 61340-5-1.
Do you believe you have a problem with ESD Control?	Y		Customer believes they may have a problem because of unknown failures but doesn't know wht might be causing it.	
If so, which areas concern you?			See above	ESD EOS Assessment recommended following implimentation of survey recommendations, to locate if there are any processes still causing ESD Events.
Do you have any unacceptably high device failure rates that are not easily explained?	Y			
How Many automated tools (i.e.pick and place machine, conveyor,over,printer,etc.) do you have in place?		N	None	

SURVEY SUMMARY

1	ESD Protected Area Clearly Identified using signs, aisle tape & EPA bonding points labeled.	
Equipment Used:	N/A	
Citation from Standard:	IEC 61340-5-1 paragraph 4.3 Signs for ESD protected areas (EPA) ESD sensitivity symbol "Sign(s) ...shall be clearly visible to personnel before they enter the EPA and, where applicable, from inside the EPA. Where applicable, signs ... shall mark the EPA boundary." Paragraph 4.4 Marking of EPA bonding points (EBP) "All EBP shall be marked or labelled." Per IEC 61340-5-2 paragraph 5.1.1 "The boundaries of the EPA need defining and will vary between different types of EPA, but will typically have coloured (but not electrostatic generative) markings on the floor."	
Name of Area:	Packing	Main EPA
Observation:	This area is identified on entrance with ESD warning signs.	This area is an open area within the factory floor, there is a sign outside the area but nothing indicating the boundaries.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1 but improvements can be made.
Correct Actions/ Recommendations:	It is recommended that some signs are added within the EPA to serve as a reminder to personnel.	It is recommended that Aisle marking tape is used to act as a 'barrier' against people entering the area unless they have taken appropriate precautions.

2	Access to ESD Protected Area controlled.	
Equipment Used:	N/A	
Citation from Standard:	IEC 61340-5-1 paragraph 5.5 EPA working practices "All persons, including visitors, entering the EPA shall comply with the requirements of this subclause" [grounded via wrist strap or ESD footwear, properly wearing ESD garments, paperwork in static dissipative document holders].	
Name of Area:	Packing	Main EPA
Observation:	Access to the EPA is controlled, only persons taking the precautions outlined in the companies ESD Control plan are allowed to enter the EPA.	Personnel are trained to only enter the area if appropriate precautions have been made, however as stated above the boundaries have not clearly been set so its very easier for someone who is not trained to enter the area.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1 but improvements can be made.
Correct Actions/ Recommendations:	N/A	See box 2.

3	Working Surfaces and storage racks, Rp 10⁴ to 10⁹ ohms, Rg 7,5 x 10⁵ to 1 x 10⁹ ohms. ESD Mat Cleaner used.	
Equipment Used:	Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.2 Working surfaces and storage racks "All working surfaces and storage racks on which unprotected ESDS may be placed shall be capable of being connected to EPA ground and shall have a point to point resistance and resistance to EPA ground in accordance with table 1 [Rp greater or equal to 1 x 10 ⁴ , less than or equal to 1 x 10 ⁹ ohms, and Rg greater or equal to 7,5 x 10 ⁵ to less than or equal to 1 x 10 ⁹ ohms]." Conductive materials conduct electricity too rapidly and a discharge may occur. Dissipative materials will drain the charges off an ESDS device at a slow enough rate to minimize the occurrence of discharges. Dirt & cleaners containing silicone are insulative and a dissipative ESD worksurface cannot fulfil its function if covered by insulative material	
Name of Area:	Packing	Main EPA
Measurement:	Rp: 3.5 x 10 ⁸ Rg: 2.6 x 10 ⁸ Rp: 3.7 x 10 ⁸ Rg: 2.8 x 10 ⁸	Working Surfaces: Rp: 1.5 x 10 ⁷ (dirty area) Rp: 7.2 x 10 ⁶ (clean area) Rg: 4.6 x 10 ⁶ Shelves: Rp: 8.30 x 10 ⁶ Rg: 1.20 x 10 ⁷
Observation:	Working surface currently in spec but looking a bit dirty in places, dirt is an insulator and can cause the surface to be out of spec.	The mats is the main area where your technician works are in a poor state of cleanliness, you can see from the above results that one the mats have been cleaned the resistance readings improve. ESD Mat Cleaner is not used, however it is available. Matting on storage racks is daisy chained, each mat should be earthed independently to the framework, when tested the framework to ground the result was Rg: 2.5 x 10 ⁴ . The reason for the Rg being higher than the Rp is because the mats are daisy chained.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	It is recommended that an ESD safe cleaner is used on the surfaces regularly to clean and maintain the surfaces.	Regular cleaning of the mats using an ESD bench and mat cleaner will improve the resistance readings and prolong their working life. We suggest grounding each shelf mat directly to the framework of the racks which in turn is earthed via the floor.

4	ESD Floors, Rg less than or equal 1 x 10⁹ ohms. If primary means of grounding personnel, Rg 7,5 x 10⁵ to 3,5 x 10⁷ ohms. Floor clean.	
Equipment Used:	Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.3 Floors "All floor surfaces shall have a surface to EPA ground resistance in accordance with table 1. Table 1 NOTE 2 - When the footwear/floor systems are used as the primary means of grounding personnel, the resistance of the combination shall be determined by the ESD co-ordinator, and is recommended to be between 7,5 x 10 ⁵ ohms and 3,5 x 10 ⁷ ohms." IEC 61340-5-1 paragraph 5.5 EPA working practices "When the use of a wrist strap system is impractical, the [ESD] floor and [ESD] footwear shall be the primary means of ESD control." Dirt is typically insulative and a dissipative ESD protected floor cannot fulfil its function if covered by insulative material.	
Name of Area:	Packing	Main EPA
Measurement:	Rg: > 10 ¹²	Rp: 1.3 x 10 ⁵ (high traffic) Rp: 5.8 x 10 ⁴ (low traffic) Rg: 4.1 x 10 ⁴
Observation:	Conductive floor mats used at each work bench was not grounded which is why it was out of spec.	In the high traffic area the Rp reading is higher than in the lower traffic area, this is purely because a small amount of dirt and debris is building up on the surface, a regular cleaning programme will give you a much more uniform Rp reading throughout your facility.
Conformance:	Outside the specification as per IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	Add grounding point to each mat and ground individually, currently they are not providing a path to ground for personnel wearing ESD footwear.	Use of ESD floor cleaner on a regular basis.

5	ESD Seating, Rg less than or equal to 1×10^{10} ohms. If ESD floor grounding, minimum of two paths-to-ground.	
Equipment Used:	Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.4 Seating "The resistance from all areas of seating which may have human body contact when in normal use, to either a floor contact point or a groundable point, shall be as specified in table 1 [Rg less than or equal to 1×10^{10} ohms]. When the floor is used as part of a grounding system, a minimum of two wheels or two feet shall provide a path to EPA ground."	
Name of Area:	Packing	Main EPA
Measurement:	N/A	Rg: 1.5×10^6
Observation:	Personnel are always stood	
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	None	None

6	ESD Protective Smocks used to cover arms and torso, Rg less than or equal 1×10^{12} ohms. Charge decay to less than 10% of original value (maximum 1,000 V). ESD Smocks marked with ESD protective symbol and properly fastened.	
Equipment Used:	Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.5 Garments "Coats, jackets, smocks and overalls shall completely cover all clothing in the area of the arms and torso. There shall be electrical continuity between all parts of the garment. Garments shall have characteristics on the outward facing surface in accordance with table 1 [Rp less than or equal to 1×10^{12} ohms; Charge decay to 10% of initial value (maximum 1 000 V) in less than 2 s]. Garments complying with ESD requirements shall be clearly marked. NOTE Marking with the ESD [protective] symbol ... is recommended." IEC 61340-5-1 paragraph 5.5 EPA working practices "When used, garments in accordance with 5.2.5 shall be worn and shall be properly fastened at all times."	
Name of Area:	Packing	Main EPA
Measurement:	Rp: 6.5×10^9	Rp: 7.3×10^9
Observation:	All personnel in the area are wearing ESD safe lab coats however we found some people were working on ESD sensitive items when their smock wasn't fastened.	All personnel in the area are wearing ESD safe lab coats and they were all fastened.
Conformance:	Not in accordance to IES 61340-5-1.	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	Personnel need to be retrained on the iportance of fastening their lab coats and the coats covering all clothing. ESDS items have the closest contact to the front of the torso so its important this part is covered by the ESD lab coat.	None

7	ESD Gloves and Finger Cots, Charge decay to less than 10% of original value (maximum 1,000 V).	
Equipment Used:	Surface Resistance Meter Kit - 222642, Digital Static Field Meter - 50597 or Customers Personal grounding Tester	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.6 Gloves and finger cots "Gloves and finger cots, as worn, shall be in compliance with table 1 [Charge decay to 10% of initial value (maximum 1 000 V) in less than 2 s].	
Name of Area:	Packing	Main EPA
Measurement:	N/A	N/A
Observation:	Cloves are not worn	Cloves are not worn
Conformance:	Yes	Yes
Correct Actions/ Recommendations:	None	None

8	Wrist Straps with current limiting resistor worn and grounded. Tested daily to Rg 7,5 x 10⁵ to 3,5 x 10⁷ ohms.	
Equipment Used:	AC Ground Analyser and Wrist Strap Tester - 224731	
Citation from Standard:	IEC 61340-5-1 paragraph 5.5 EPA working practices "The primary means of grounding personnel shall normally be by a wrist strap connected to an EBP." Paragraph 5.2.7 "The wrist strap shall consist of a band that fits snugly around the wrist and a cord to connect the band to an EBP. The wrist strap shall incorporate a quick release connection. The cord shall have a termination compatible with the EBP and shall incorporate at least one insulated current limiting resistor. The total resistance from hand to EBP shall be in accordance with table 1 [Rg 7,5 x 10 ⁵ to 3,5 x 10 ⁷ ohms]. IEC 61340-5-2: Paragraph 5.1.1 General "A nominal 1 megohm resistor is commonly used in wrist straps and to ground work surfaces. In the event of an operator touching an energized conductor, for the normal mains electricity supplies this resistor will limit the current flowing through the person to less than 0,5 mA. Current limiting or cut-off devices should also be considered and in some areas may be demanded by legislation."	
Name of Area:	Packing	Main EPA
Observation:	Wrist straps are worn and used with continuous monitors, we tested a couple of examples and they passed.	Wrist straps are worn and used with continuous monitors, we tested a couple of examples and they passed.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	None	None

9	Continuous Monitors used or daily Touch Testing of Wrist Straps flexing resistor area. Results logged.	
Citation from Standard:	Per IEC 61340 5 1 paragraph 9.6 Daily checks, paragraph 9.6.2 Wrist strap "Wrist straps shall be checked before use. Each check shall be made with the wrist band worn in contact with the wearer's skin and with the ground cord attached to the appropriate tester." Reference IEC 61340 4 1, per A.5.2 Measurement method for wrist strap testing, "Where continuous monitoring is used, no additional testing is required."	
Name of Area:	Packing	Main EPA
Observation:	Continuous monitors are at each bench, not daily testing is required. The units hadn't been calibrated for 13 months.	Continuous monitors are at each bench, not daily testing is required. The units hadn't been calibrated for 13 months.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	It is recommended that the continuous monitors are calibrated at least once a year.	It is recommended that the continuous monitors are calibrated at least once a year.

10	Foot Grounders used in conjunction with ESD Floor touch tested daily prior to entering EPA. Rg be between 7,5 x 10⁵ ohms and 3,5 x 10⁷ ohms.	
Equipment Used:	Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.8 "Footwear shall be constructed in such a way that for each item, the resistance to EPA ground from wearer shall be in accordance with table 1. Table 1 NOTE 2 - When the footwear/floor systems are used as the primary means of grounding personnel, the resistance of the combination shall be determined by the ESD co-ordinator, and is recommended to be between 7,5 x 10 ⁵ ohms and 3,5 x 10 ⁷ ohms." IEC 61340-5-1 paragraph 5.5 EPA working practices "When the use of a wrist strap system is impractical, the [ESD] floor and [ESD] footwear shall be the primary means of ESD control." Per IEC 61340 5 1 Daily checks, paragraph 9.6.3 Non permanent footwear "All wearers shall check that their heel and toe straps meet requirements. The check shall be made before entering the EPA."	
Name of Area:	Packing	Main EPA
Measurement:	N/A	
Observation:	Foot grounders are worn as a second precaution but are not tested. An ESD floor/footwear grounding system isn't currently included in the ESD control programme as they don't deem it necessary when continuous monitors are used.	Foot grounders are worn as a second precaution but are not tested. An ESD floor/footwear grounding system isn't currently included in the ESD control programme as they don't deem it necessary when continuous monitors are used. However we saw that personnel were walking round the area with ESDS item loose so they are using the footwear and grounding system without wrist straps sometimes.
Conformance:	N/A	N/A
Correct Actions/ Recommendations:	It is correct that when personnel are at the work benches and grounded through the wrist strap and continuous monitor that a footwear/flooring grounding system would be a second precaution. However if personnel walk around the room not grounded by wrist strap with an ESD sensitive item not in a shielding container the product will not be protected from ESD.	If personnel are to continue walking around the EPA with ESDS items not in shielding containers then footwear should be tested daily and results logged, flooring should also be tested on a regular basis.

11	Ionizers to reduce charges on insulators to less than 100 volts in less than 20 seconds.	
Equipment Used:	Ion Test kit - 50598	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.9 "Ionizers shall enable either polarity of charge on items to be brought down and maintained to less than 100 V in accordance with table 1 [To decay from 1 000 V to 100 V in 20 s maximum]."	
Name of Area:	Packing	Main EPA
Measurement:	N/A	N/A
Observation:	No ionisers used in this area	No ionisers used in this area
Conformance:	N/A	N/A
Correct Actions/ Recommendations:	N/A	N/A

12	Tools & equipment groundable or low charging with no insulative handles	
Equipment Used:	Digital Static Field Meter - 50597 and Low Resistance Tester - 222645	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.10 "Tools intended for use within the EPA shall, as far as is practicable, be so constructed that they do not generate or hold an electrostatic charge and are in compliance with table 1 [Rg less than or equal to 1×10^{12} ohms; Charge decay to 10% of initial value (maximum 1 000 V) in less than 2 s]. All tools and machinery, for example electrical, mechanical or pneumatic, shall be so constructed that any non insulating part of the tool or machine which may touch an ESDS shall be at EPA ground potential. All electric solder irons used within the EPA shall be fitted with a grounded tip." IEC 61340-5-2 paragraph 5.2.10 "Tools with insulated handles should not be used. If highly conductive tools (metal) are to be used for an essential process, then the highly conductive part may contain residual charge. Before the tool is used, the residual charge should be removed through a resistance of less than 10^{12} ohms to ground. This will often be integral in the handle, and for small tools the charge will be removed through the operator or the working surface."	
Name of Area:	Packing	Main EPA
Measurement:	We found that the insulative parts of the items listed below all generated over 1000 V, the tape up to 5000 V.	Some tools generating up to 1000 V on their insulative handles.
Observation:	A number of insulative material are kept in the work area. E.g. Non-ESD safe tape in an insulative tape dispenser and screw drivers.	Some tools were found to be ESD safe others were found to be non-ESD safe.
Conformance:	Not in accordance to IES 61340-5-1.	Not in accordance to IES 61340-5-1.
Correct Actions/ Recommendations:	It is recommended that each of these items are replaced with ESD safe alternatives	It is recommended that each of these items are replaced with ESD safe alternatives

13	Trolleys / equipment grounded; Rp 10^4 to 10^9 ohms, Rg $7,5 \times 10^5$ to 1×10^9 ohms.	
Equipment Used:	Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340-5-1 paragraph 5.2.11 Trolleys and carts "When used for transporting unprotected ESIDS or as portable work surfaces, they shall conform to the requirements of 5.2.2 [Working surfaces and storage racks 'All working surfaces and storage racks on which unprotected ESDS may be placed shall be capable of being connected to EPA ground and shall have a point to point resistance and resistance to EPA ground in accordance with table 1 [Rp greater or equal to 1×10^4 , less than or equal to 1×10^9 ohms, and Rg greater or equal to $7,5 \times 10^5$ to less than or equal to 1×10^9 ohms]' and shall contain a groundable point.	
Name of Area:	Packing	Main EPA
Measurement:	N/A	Rp: 8.7×10^4 Rg: 5.0×10^{11}
Observation:	Trolleys are not used in this area.	The trolleys do not have a means to ground as the castors on the trolleys are insulative.
Conformance:	N/A	Not in accordance to IES 61340-5-1.
Correct Actions/ Recommendations:	N/A	A drag chain could be added to the trolleys to ground them through the floor, if these are added the resistance to ground should be re tested to check they are within spec. Alternatively, item could only be placed on the trolley if in closed shielding containers.

14	Electrostatic field areas , if over 10kV/m, should be declassified, marked, and not considered part of the EPA.	
Equipment Used:	Digital Static Field Meter - 50597	
Citation from Standard:	IEC 61340-5-1 paragraph 5.3.5 Electrostatic fields "ESDS should not be exposed to electrostatic fields in excess of 10 kV/m. This can be difficult to measure in many cases, and an alternative, but still difficult to measure, is to limit the electrostatic potential to 100 V. In some cases, equipment capable of generating electric fields or electrical potentials above the 10 000 V/m limit must be used inside an EPA. Should this happen, then the area where the non-compliant field may be present should be declassified and not be considered part of the EPA. This declassified area needs to be marked, and ESIDS kept out of the area."	
Name of Area:	Packing	Main EPA
Measurement:	See Box 13, Tools and Equipment	See Box 13, Tools and Equipment
Observation:	Multiple high charging insulative items were found at the work bench and had potential to be within 30cm of ESDS items.	Multiple high charging insulative items were found at the work bench and had potential to be within 30cm of ESDS items. Include Polystyrene which the field meter showed generations of up to 15kV.
Conformance:	Not in accordance to IES 61340-5-1.	Not in accordance to IES 61340-5-1.
Correct Actions/ Recommendations:	It is recommended that these items are removed from the work benches and replaced with ESD safe alternatives is necessary and where possible. If these materials are necessary and cannot be substituted then you will need to neutralize any charges on them by installing ionisers into the area.	It is recommended that these items are removed from the work benches and replaced with ESD safe alternatives is necessary and where possible. If these materials are necessary and cannot be substituted then you will need to neutralize any charges on them by installing ionisers into the area.

15	Check Ground to EPA ground bonding point (EBP) and EPA ground facility; recommend hard ground less than 2 ohms.	
Equipment Used:	AC Ground Analyser and Wrist Strap Tester - 224731 and Low Resistance Tester - 222645	
Citation from Standard:	IEC 61340-5-1 paragraph 5.3.2 "The EPA ground facility shall be connected to EPA ground and provide a low resistance path to EPA ground (<2 ohms). When available, the mains protective earth shall be used. Paragraph 5.3.3 "An easily accessible dedicated EBP [EPA ground bonding point] for the wrist strap shall be established adjacent to each working area, or working surface. A sufficient number of EBP shall be provided for operators and visitors." Paragraph 5.3.4 "EPA ground cords shall be used to make electrical connections between groundable points and the EPA ground facility."	
Name of Area:	Packing	Main EPA
Observation:	Ground is via mains earth, it was tested and found to be good.	Ground is via mains earth, it was tested and found to be good.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	None	None

16	Paperwork in static dissipative Document Holders.	
Equipment Used:	Digital Static Field Meter - 50597	
Citation from Standard:	IEC 61340-5-1 "Paperwork inside the EPA shall either be kept in containers conforming to the requirements of table 2 or shall not generate a field in excess of that specified in paragraph 5.3.5 [ESDS should not be exposed to electrostatic fields in excess of 10 kV/m]." Insulative paper, placed upon ESD protected worksurface, can easily interrupt path-to-ground.	
Name of Area:	Packing	Main EPA
Observation:	Some paperwork is loose and not in antistatic document wallets, however most paperwork is filed in static dissipative Ring Binders and Document wallets.	Paperwork was found loose at the work benches but always stuck to the back wall, personnel know not to place ESDS items on top of paper.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	None	None

17	For Packaging Outside EPA, use Shielding Bags or other ESD packaging for transportation or storage of ESD sensitive items.	
Equipment Used:	Digital Static Field Meter - 50597 and Surface Resistance Meter Kit - 222642	
Citation from Standard:	IEC 61340 5 1 paragraph 6 Protective packaging states "The primary functions of protective packaging outside the ESD Protected Area are to: limit tribo electric charging, provide shielding against electrostatic fields and discharges, [and] the packaging shall be capable of providing charge drainage to EPA ground when brought into an EPA. Per paragraph 4.1.2 "identified with ESD packaging symbol, manufacturer, and batch identification number". IEC 61340-5-1 Table 2 "Intimate: Either low-charging and electrostatic conductive or low-charging and electrostatic dissipative (for powered ESDS only low-charging and electrostatic dissipative above 1×10^8 ohm shall be used). Proximity: Electrostatic discharge shielding."	
Name of Area:	Packing	Main EPA
Measurement:	Rp: 4.3×10^8	Rp: 4.3×10^8
Observation:	Before ESDS components leave the EPA they are packed on parts trays, sealed in MVB bags with HIC and desiccant and labeled as an ESDS device. Parts trays measured resistivity of 4.3×10^8 .	Before ESDS components leave the EPA they are packed on parts trays, sealed in MVB bags with HIC and desiccant and labeled as an ESDS device. Parts trays measured resistivity of 4.3×10^8 .
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	None	None

18	For Packaging Within EPA: 1) non-ESD items in low charging & ESDS [even if defective] in low charging & dissipative packaging 2) non-ESD packaging prohibited.	
Equipment Used:	Digital Static Field Meter - 50597	
Citation from Standard:	Note: Per IEC 61340 5 1 paragraph 7.3 "ESDS found to be faulty shall be protected in the same manner as any other ESDS up to the time of disposal." All non ESDS items brought into an ESD Protected Area shall be packed in low charging, dissipative ESD packaging. "The outer surface of all proximity packaging brought into an EPA shall not be insulating." "Non ESD protective packaging material shall not be taken into an EPA." IEC 61340-5-1 paragraph 5.5 EPA working practices "All non ESDS items brought into EPA shall be packed in accordance with table 2 which is minimum of "low-charging." Packaging per Table 2 for ESDS brought into EPA is "Intimate: Either low-charging and electrostatic conductive or low-charging and electrostatic dissipative (for powered ESDS only low-charging and electrostatic dissipative above 1×10^8 ohm shall be used). Proximity: Low-charging and Electrostatic discharge shielding or low-charging and electrostatic conductive or electrostatic dissipative."	
Name of Area:	Packing	Main EPA
Measurement:		
Observation:	E9 static dissipative boxes are used for storage of none ESD sensitive items. Moisture Barrier bages are readily available for use. Pink antistatic bubble wrap used for physical protection of goods. However some standard cardboard and polythene is in the area.	Conductive parts binsa re used to store none ESDS items. Moisture Barrier bages are readily available for use. Pink antistatic bubble wrap used for physical protection of goods.However as mentioned above some Polystyrene was found I the area.
Conformance:	No	No
Correct Actions/ Recommendations:	It is reommended that the cardboard and polythene is removed from the EPA.	It is recommended that the polystyrene is removed from the area.

19	ESD sensitivity symbol labels used to Identify ESDS items	
Equipment Used:	N/A	
Citation from Standard:	IEC 61340-5-1 paragraph 7.4 Unpacking, Inspection and storage within an EPA "Warning labels shall be used on all packages containing ESDS. Where these have been removed to gain access to the contents, fresh warning labels shall be used to re seal the packages."	
Name of Area:	Packing	Main EPA
Observation:	ESD Sensitivity labels are used to identify ESDS devices.	ESD Sensitivity labels are used to identify ESDS devices.
Conformance:	Yes to IEC 61340-5-1	Yes to IEC 61340-5-1
Correct Actions/ Recommendations:	None	None

SUMMARY

An efficient and cost effective ESD Control program should be treated as an on-going process, like any good quality control system. As such, it should never be treated as an event.

All ESD Control costs should provide the user with improved quality (finished products that pass final test without rework) and increased reliability (few returned items). Through improved quality and reliability, the user should achieve a Return On Investment (ROI) for every dollar spent. Lucent reports a 95:1 ROI for ESD Control. The range from other companies reported in articles is for a low of 5:1 to 20:1.

Major companies like IBM and HP state that 25% of all unidentified failure to electronics is a result of ESD. To maximize your ROI, highest loss operations, areas and products should be identified first. Then a corrective plan should be developed and evaluated. Once the corrective plan is determined, the ESD controls should be implemented and the resulting quality monitored. The effectiveness of the plan should then be evaluated and the plan refined if necessary. This process should be repeated as necessary until quality and reliability are at a level deemed acceptable to the company and their customers.

By keeping ESD Control an on-going quality process, program costs and resulting ROI can be monitored so that the company can maximize total program value.

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