DESCO EUROPE

ESD CONTROL SURVEY - REPORT

Survey at: Example Company
Address: Example Address

For: Example Name
Email: Example address

Survey Date: 2019-04-24
Report Date: 2019-05-01
Prepared by: Olivia Berwick

Distributor: Example Distributor
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INTRODUCTION

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 your 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.

Per IEC 61340-5-1 paragraph 1 “This part of IEC 61340 applies to activities that: manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment with withstand voltages greater than or equal to 100 V HBM, 200 V CDM and 35 V for isolated conductors. ESDS with lower withstand voltages may require additional control elements or adjusted limits. Processes designed to handle items that have lower ESD withstand voltage(s) can still claim compliance to this standard.”

ADDITIONS

The Desco Europe ESD Survey will check ESD control items and compare to the limits of IEC 61340-5-1 Edition 2.0 2016-05.

There are some additions to EN 61340-5-1:2016 that should be addressed, and likely require a review and update of the company’s written ESD control plan. Added is a requirement in clause 5.2.3 for a Product Qualification Plan. This can be performed by relying upon a trusted supplier’s product data sheets and should be documented with a list maintained of specific ESD control products permitted to be used in the company’s ESD control program.

The withstand voltage of ESD sensitive items (ESDS) is that voltage where the electronic component still passes quality control tests. It may fail at a higher ElectroStatic Discharge voltage. There are a number of models testing for withstand voltage; they include the Human Body Model (HBM), and the Charged Device Model (CDM) which list classifications. Previously EN 61340-5-1 was written to cover ESDS having a withstand voltage of HBM 100 volts or higher. New is adding CDM 200 volts or higher. Also new is that the company “shall document the lowest ESD withstand voltage(s) that can be handled” (clause 2.1.1).

A general fundamental rule of ESD control is to ground all conductors including people in the EPA. If a conductor is ungrounded, it is referred to as an isolated conductor. New to EN 61340-5-1 is the requirement that an isolated conductor has a maximum charge of ±35 volts (clause 5.3.4.3). An isolated conductor can have its charge neutralised by an ioniser. So, the offset voltage (balance) limit for ionisation has been reduced to < ±35 volts.

New is a 1-inch rule (less than ±125 volts). Items that can charge more than ±125 volts should be removed from the EPA, or kept 2.5cm from ESDS, or the charge can be neutralised by an ioniser.

WRITTEN ESD CONTROL PLAN

Written ESD Control Plan- a written ESD Control Plan provides the “rules and regulations”, the technical requirements for your ESD Control Program. This should be a controlled document, approved by upper management initially and over time when revisions are made. It should be in accordance with IEC 61340-5-1 technical requirements.

QPL - The purpose of a Qualified Products List (QPL) is to ensure that:

1. A list of EPA ESD control items is used in the ESD control Plan producing a summary of the Product Qualification Plan.
2. Only approved ESD control products are purchased, thus controlling the ESD protective products used to only those that meet both minimum performance criteria and your company’s specific needs.
3. To assure that all products used will work together to ensure continued ESD Control Program improvements and to address necessary program changes.

Compliance Verification Plan- Once the ESD control program is set up, it is important to implement a compliance verification program which includes periodic checking of EPA ESD control items, and calibration of test equipment per manufacturer and industry recommendations.

Training Plan- An ESD Program is only as good as the use of the products by personnel. When personnel understand the concepts of ESD, the importance to the company of the ESD control program, and the proper use of ESD products, they will implement a better ESD control program improving quality, productivity, and reliability.

IEC 61340-5-1 GOAL

To work towards becoming IEC 61340-5-1 compliant we recommend that you start with a clean copy of IEC 61340-5-1 and highlight every “shall” & “must”. Compare this to your current ESD control plan document and address all shall / must requirements.

IEC 61340-5-1 Tables 1, 2, and 3 provide an excellent list to identify all of your ESD control items from which you decide and document which of them to make them a requirement in your program. Thus, these will need to be addressed in your ESD Control Plan and/or Compliance Verification Plan. This is also a good point to start laying out your QPL – Qualified Parts List of all the ESD control products allowed to be used in your program. This list should not be a static document as new items will be added (or deleted) as your needs change and your program matures.

COMPANY OVERVIEW

Description of Company:		Manufacture and test fire alarm systems for home and business use.
Number of Facilities:		5
Current ESD Concerns:		None
Approximate Number of Operators at this facility involved with ESD Control:		50
Current ESD Control Program Consists of:	**Written ESD Control Plan**	No
	QPL (Qualified Parts List) – List of approved ESD protective products	No
	Compliance Verification Plan	No
	Training Plan	Yes
	Product Qualification	No
How Many automated tools (i.e. Pick and place machine, convey or, over, printer, etc.) do you have in place?		6
What level is your most sensitive device, both in terms of HBM and CDM?		Unknown

SURVEY DATA

Equipment Used: Desco EUROPE 222687 ESD Survey Kit

Serial Number:

Calibration Date:

Areas:	Name:
1	Manufacturing Lab

1. GROUNDING

1.1	**Check Ground -** three-wire AC electrical outlets equipment ground properly wired or Functional Grounded Bonded to Protective Earth	**Area/s:**	**In spec?**
Observation	Grounding system is using protective earth	1	Yes
Measurement	Using AC Outlet Analyzer, outlets checked were properly wired.	1	Yes
Recommendation	No corrective action required.		

2. PERSONNEL GROUNDING

<table>
<tr><td rowspan="2">2.1</td><td colspan="3">Personnel Grounding Verification - (Wrist Straps, Footwear, and Groundable Static Control Garment Systems) tested while worn with results logged.</td></tr>
<tr><td></td><td>Area/s:</td><td>In Spec?</td></tr>
<tr><td rowspan="5">Observation</td><td colspan="2">Operator touch-testing of personnel grounding devices is required before each shift.</td><td>1</td><td></td></tr>
<tr><td colspan="2">Touch-test results are logged on paper</td><td>1</td><td>Yes</td></tr>
<tr><td colspan="2">Calibration date is within one-year / current on all touch-testers.</td><td>1</td><td>Yes</td></tr>
<tr><td colspan="4">Number of touch-testers currently in place:1 - 5</td></tr>
<tr><td>Number of operators currently wearing:</td><td colspan="3">Wrist Straps: 40 - 50
Foot Grounders: 40 - 50
Groundable Static Control Garment: 40 - 50</td></tr>
<tr><td>Recommendation</td><td colspan="4">No corrective action required.</td></tr>
<tr><td>Informational</td><td colspan="4">Operator grounding is the foundation of any ESD Control Program. Therefore, if not using continuous monitors, the daily testing that the grounding device is both operating and worn correctly is paramount.

Consider converting to Testers with data acquisition automatically maintaining compliance verification records to provide evidence of conformity to the technical requirements.

Consider continuous or constant monitor systems that allow you to continually monitor the operator and wrist strap path to ground to avoid the need for periodic testing of wrist straps and the logging of test results.

Wrist straps are stressed and flexed to their limits at a workstation. While a wrist strap is being checked, it is not stressed, as it would be under working conditions. Opens in the wire at the coiled cord’s stain relief are sometimes only detected under stress.

If the wrist strap system is checked at the beginning of a shift and subsequently fails, then an entire shift’s work could be suspect.

When considering constant monitors, the equipment cost including the wrist strap, maintenance and training cost, labor time for performing wrist strap tests, and the potential failures due to non-functional wrist straps should be considered.</td></tr>
</table>

2.2	**<u>Wrist Straps</u>** worn and grounded when seated. With the resistance of operator-to- ground Required Limit measured at < 3.5 X 10^7 ohms. This is also the upper limit if ESD Garment is used as part of personnel path to ground.			
			Area/s:	**In Spec?**
Observation	All seated operators are wearing properly grounded wrist straps.		1	Yes
	Identified operator(s) wearing wrist strap, but it was grounded via a stud on the work surface.		1	NR
Measurements	**Result:**	**Comment:**		
	Rg: 3.8. x 10^ 6 ohms		1	
Recommendation	Wrist straps should be grounded via a common ground point, it is not recommended that they are grounded via the work surface as it can increase the total system resistance to ground so that it is over the required limit.			
Informational	With a wrist strap with an elastic wristband, while the primary ground contact to the operator's skin is the metal wristband buckle, the elastic wristband itself has conductive fibers. These will lose their conductivity over time. It is a good idea to test the wrist strap periodically by holding the interior of the wristband instead of wearing it. If the wristband fails, replace the elastic band or entire wristband. Consider purchasing wrist strap components as opposed to kits. A good quality static control garment can be used as part of the "Operator Grounding System". Consider groundable static control garment with ground snap at the hip and conductive cuffs to allow operators to be grounded "hands free" and save the cost of the wristband.			

2.3	**ESD Footwear** on each foot for mobile personnel. Footwear and Foot Grounder resistance should be at a maximum < 1 x 10^8 ohms. The user should establish the upper limit in product qualification of the footwear/flooring system.			
			Area/s:	**In Spec?**
Observation	Has the company established an upper limit from product qualification, is so what?	No		
	Operators wear foot grounders on both feet.			Yes
	Operators test foot grounders while worn using a footwear tester.			Yes
	Touch-Tester upper limit for foot grounders is believed to be 100 meghom but not confirmed.			
	Operators do not test foot grounders while worn			No
	ESD Foot Grounders currently used:	Heel Grounder		
Measurements	**Result:**	**Comment:**		
	Pass		1	
Recommendation	No corrective action required.			

2.4	**ESD Floor** grounded and clean. Flooring **Required Limit is** < Rg 1 X 10^9 ohms			
			Area/s:	**In Spec?**
Observation	Conductive			
	The Floor is:	Paint		
	Floor needs cleaning.		1	
	Floor is used as primary ground for:	Mobile equipment (like carts)	1	
		Standing / mobile operators	1	
Measurements	**Result:**	**Comment:**		
	Rg: 12.6 x 10^ 8 ohms	Where the floor had visibly worn under a chair.		
	Rg: 11.8. x 10^ 7 ohms	In the SMT area		
Recommendation	In order to maintain the ESD properties of the ESD floor, proper ESD cleaners and flooring products should be used when maintaining the floor, as standard solutions can add an insulative layer and damage the flooring over time. All ESD flooring products should be systematically tested for Rg using a resistance meter with a 5 lb. Electrode. This should become part of a regular compliance verification plan. It is recommended that floors are confirmed at least two to four times per year. Consider ESD conductive mats/runners for high traffic areas (under chairs and around SMT/Wave/Oven type machinery) where floor finish will wear sooner.			
Informational	Concrete, unless specifically formulated to be an ESD Floor, cannot be considered as ESD protective. Concrete is hygroscopic (easily absorbing moisture) and the resistance is achieved by the moisture in the concrete. Since the moisture level will change as relative humidity changes, the resistance will vary. It is important to note that static charging is at its highest at low relative humidity conditions, an untreated concrete floor will perform the worst, having high resistance due to the reduced amount of moisture.			

<table>
<tr><td>2.5</td><td colspan="3"><u>ESD Footwear / Flooring Systems</u> Required Limit is:

• Compliance Verification - Measure less than 1 x 10^9 ohms which is the maximum value allowed. Th4 user should establish an upper limit in product qualification.
• Product Qualification - Measure both resistance < 1 X 10^9 ohms AND body charge generation to be less than 100 volts peak.</td><td>Area/s:</td><td>In Spec?</td></tr>
<tr><td>Observation</td><td colspan="2">Grounding mobile personnel is part of the ESD Control Plan</td><td>1</td><td>Yes</td></tr>
<tr><td rowspan="2">Measurements</td><td>Result:</td><td>Comment:</td><td></td><td></td></tr>
<tr><td>Rg: 4.8. x 10^ 9 ohms</td><td>Where the floor had visibly worn under a chair.</td><td>1</td><td>No</td></tr>
<tr><td>Recommendation</td><td colspan="4">Rg is > 1 X 10^9 ohms, problem is high floor resistance (table 2.4).
• Reduce floor Rg to conductive level
• Purchase necessary equipment to test for Operator Charge Generation of < 100 volts peak.
Note: the measurement is resistance in series adding together all the resistance of all the elements operator / footwear / floor. In this case, the floor resistance is too high.

Reduce floor charging properties by use of Dissipative Floor Finish that is formulated to reduce charge generation to < 50 volts.

Add conductive mats/runners for high traffic areas (under chairs, around SMT/Wave/Oven type machinery) where floor finish will wear sooner. See Flooring table 2.4.</td></tr>
<tr><td>Informational</td><td colspan="4">Foot grounders should be UL Listed.

The larger the foot grounder heel/sole surface, the greater the probability that the operator will be continuously in contact with the ESD flooring and thus grounded.</td></tr>
</table>

3. ESD Protected Area – TECHNICAL ELEMENTS

3.1	**ESD Protected Area (EPA) Clearly Identified** - Caution signs indicating the existence of the EPA shall be posted and clearly visible to personnel prior to entry to the ESD protected area.	**Area/s:**	**In Spec?**
Observation	ESD Protected Area is clearly identified by signs and floor aisle tape.	1	Yes
Recommendation	No corrective action required.		
Informational	**An ESD Protected Area** is a defined location with the necessary materials, tools and equipment capable of controlling static electricity to a level that minimizes damage to ESD susceptible items.		

3.2	**Access** to ESD Protected Area (EPA) controlled	**Area/s:**	**In Spec?**
Observation	Access is controlled, only persons that have received ESD Training are allowed to enter this ESD protected area, visitors are escorted, and personnel grounding items tested with results logged.	1	Yes
Recommendation	Convert to Testers with data acquisition automatically maintaining compliance verification records and controlling access into the ESD protected area.		
Informational	**An EPA can consist of a single workstation, entire room or building.** Handling of ESD susceptible parts, assemblies and equipment in packaging without ESD shielding shall be performed only in an ESD protected area. Access to the ESD protected area shall be limited to personnel who have completed appropriate ESD Training and inclusion in written ESD Control Plans can help this.		

<table>
<tr><td>3.3</td><td colspan="5"><u>EPA Worksurfaces</u> – Required limit is <1 X 10^9 ohm Rg. Properly grounded to common point ground, maintained using ESD Mat Cleaner.</td></tr>
<tr><td rowspan="4">Observation</td><td colspan="3"></td><td>Area/s:</td><td>In Spec?</td></tr>
<tr><td colspan="2">ESD worksurfaces are:</td><td>2-layer rubber mat</td><td>1</td><td>No</td></tr>
<tr><td colspan="3">ESD worksurfaces are NOT clean.</td><td></td><td>No</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="5">Measurements</td><td>No</td><td>Result/results:</td><td>Observation and description:</td><td></td><td></td></tr>
<tr><td rowspan="2">1</td><td>Original Rg: 3.5 x 10^ 6 ohms</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Yes</td></tr>
<tr><td>Rp: 8.6 x 10^ 7 ohms</td></tr>
<tr><td rowspan="2">2</td><td>Original Rg: 4.5 x 10^ 7 ohms</td><td rowspan="2">Surface needs a clean, starting to lose ESD safe properties</td><td rowspan="2">1</td><td rowspan="2">No</td></tr>
<tr><td>Rp: 5.7 x 10^ 9 ohms</td></tr>
<tr><td>Recommendation</td><td colspan="5">When the Rg measures high and the Rp doesn't, check attachment and integrity of ground wires.

Use approved ESD cleaners in order to maintain ESD worksurfaces.

Consider continuous monitor systems that allow you to continually monitor the path to ground of the worksurface.</td></tr>
<tr><td>Informational</td><td colspan="5">A "soft" surface is often easier to work on than a hard, slick surface. Using a soft mat will often improve charge removal from charged conductors placed on the surface because of increased surface area contact, rather than "point contact" which tends to increase contact resistance.

The purpose of the ESD worksurface is two-fold: (1) to provide a surface that has no charge on it. (2) To provide a surface that will remove charges from all conductors (including ESD susceptible devices and assemblies) that are placed on the surface. When two different objects are at a different charge, a ESD event or discharge will occur when in close enough proximity or when contact is made. To reduce Charged Device Model (CDM) concerns the worksurface Rp should not be < 1 x 10^4 ohms or the discharge may occur too quickly.</td></tr>
</table>

<table>
<tr><td>3.4</td><td colspan="3"><u>Shelves</u> are considered a worksurface if unprotected ESD susceptible items are placed on it and therefore the Rg is required to be < 1 x 10^9 ohms.</td><td>Area/s:</td><td>In Spec?</td></tr>
<tr><td>Observation</td><td colspan="3">Shelves are part of the ESD Control Program and thus considered part of an ESD worksurface.</td><td>1</td><td></td></tr>
<tr><td rowspan="3">Measurements</td><td>No</td><td>Result/results:</td><td>Observation and description:</td><td></td><td></td></tr>
<tr><td rowspan="2">1</td><td>Original Rg: 11.8 x 10^ 12 ohms</td><td rowspan="2">Insulative plastic was found connecting each shelf to the legs of the shelving meaning each shelf was isolated.</td><td rowspan="2">1</td><td rowspan="2">No</td></tr>
<tr><td>Rp: 7.2 x 10^ 3 ohms</td></tr>
<tr><td>Recommendation</td><td colspan="5">When shelf Rg measures high and the Rp doesn’t, check attachment and integrity of ground wires.

All ESD shelves should be systematically tested for Rg using a resistance meter with 5 lb. Electrode. This should become part of a regular compliance verification plan. Shelves should be confirmed at least two to four times per year and whenever a shelf is moved.</td></tr>
<tr><td>Informational</td><td colspan="5">Shelves are an optional part of your ESD Control Plan. If ESD susceptible devices are packaged in closed ESD shielding containers, the shelf may not have to be grounded.

When shelves are too conductive they can pose a CDM (Charged Device Model) hazard to ESD susceptible items that are not properly packaged.</td></tr>
</table>

<table>
<tr><td>3.5</td><td colspan="4"><u>Mobile Equipment – Trolleys, racks, carts</u> are considered a worksurface if unprotected ESD susceptible items are placed on it and therefore the Rg < 1 x 10^9 ohms.</td><td>Area/s:</td><td>In Spec?</td></tr>
<tr><td rowspan="3">Observation</td><td colspan="4">ESD mobile equipment are NOT properly identified by signage.</td><td></td><td>No</td></tr>
<tr><td colspan="4">Mobile equipment is connected to the ESD floor via use of a drag chain.</td><td></td><td></td></tr>
<tr><td colspan="4">Insulators found on ESD Trolleys</td><td></td><td></td></tr>
<tr><td rowspan="5">Measurements</td><td>No</td><td colspan="2">Result/results:</td><td>Observation and description:</td><td></td><td></td></tr>
<tr><td rowspan="2">1</td><td colspan="2">Original Rg: 5.2 x 10^ 10 ohms</td><td rowspan="2">Potentially caused by poor connection to the ESD safe flooring or caused by floor resistance being too high.</td><td rowspan="2">1</td><td rowspan="2">No</td></tr>
<tr><td colspan="2">Rp: 3.1 x 10^ 6 ohms</td></tr>
<tr><td rowspan="2">2</td><td colspan="2">Original Rg: 4.1 x 10^ 10 ohms</td><td rowspan="2">Potentially caused by poor connection to the ESD safe flooring or caused by floor resistance being too high.</td><td rowspan="2">1</td><td rowspan="2">No</td></tr>
<tr><td colspan="2">Rp: 6.7 x 10^ 7 ohms</td></tr>
<tr><td>Recommendation</td><td colspan="6">If the resistance to ground is still out of spec once the flooring resistance has been reduced, replace drag chains with a more reliable system
• Conductive casters
• Use ground cord attached to a common point ground when stationary

All ESD trollies should be systematically tested for Rg using a resistance meter with 5 lb. Electrode. This should become part of a regular compliance verification plan. Cart shelves should be confirmed at least two to four times per year and whenever a shelf is moved.

Remove all insulators from ESD Trollies.</td></tr>
<tr><td>Informational</td><td colspan="6">Trollies are an optional part of your ESD Control Plan. As long as ESD susceptible devices are packaged in ESD shielding ESD containers while stored or transported, the trolleys may not have to be grounded.

When trollies worksurface shelf liners are too conductive they can pose a CDM (Charged Device Model) hazard to ESD susceptible items that are not properly packaged.</td></tr>
</table>

3.6	ESD Workstation is clear of **Insulators** such as regular high charging bags, packaging, document holders, binders & tape, gloves > ±125 volts			
			Area/s:	**In Spec?**
Observation	Insulators ARE present.			No
	No paper on work surfaces			
	Personnel do NOT wear gloves when working with ESDS items		1	Yes
Measurements	**Result:**	**Description:**		
	8,000V	Blue box on ESD safe worksurface	1	No
	13,000V	On Masking tape	1	No
Recommendation	Insulators can be controlled in several methods: • Remove the item from the EPA • Replace insulators with an ESD protective version • Periodically coat with Reztore Topical Antistat • Use ionisers to neutralise the charge on the item • Permanently secure in place keeping insulators that can charge ±125 volts or greater a minimum of 2.5cm from ESD susceptible items at all times (30cm from ESDS if can charge ±2,000 volts or greater) Replace tape with an ESD conductive/dissipative and/or low charging version. A tape with ESD symbols will allow you to positively identify that an ESD tape is being used.			

3.7	**<u>Ionisers</u>** Maximum discharge time of 20 seconds for 1 000 V to 100 V and –1 000 V to –100 V or user defined. Offset voltage (balance) to be less than ± 35 V.				
				Area/s:	**In Spec?**
Observation	Ionisers are NOT part of the ESD Control Program.			1	
	PCB's are handled on automated handling equipment (like pick and place equipment).				
Measurements	**The following items were identified and were charged to > 125 volts. Voltage and distance measured are listed.**				
	Volt:	**Distance:**	**Item Description:**		
	Offset voltage and discharge times of Ionisers				
	+ Time	**-Time**	**Offset Voltage**		
Recommendation	No corrective action required.				
Informational	The primary functions of ionizers are to: • Discharge / Neutralise process necessary insulators that can charge ESDS devices / assemblies via induction, thus creating potential CDM damage, and/or • Discharge / Neutralise ESDS devices / assemblies that are not grounded, thus are an isolated conductor, thus creating potential CDM damage, and/or • Discharge / Neutralise insulators where particulate contamination can cause visual defects (for example – dust on plastic or glass lenses, attracted to / held in place by Electrostatic Attraction [ESA])				

3.8	**Seating**, Rg less than or equal to 1 x 10^9 ohms if part of ESD program		
		Area/s:	**In Spec?**
Observation	ESD Chairs are NOT part of the ESD Control Program.	1	N/A
Recommendation	No corrective action required.		
Informational	The wheels of chairs can often accelerate “floor” abrasion as dirt on the wheels can act like a “rotary sander” on the floors. Consider use of vinyl matting. Grounded, conductive version for ESD protected areas. Vinyl tends to have better “lay-flat” characteristics than polyethylene materials.		

3.9	**<u>Static Control Garments</u>** used to cover workers synthetic insulative clothing, Rp < 10^11 ohms. **<u>Groundable Static Control Garments</u>** used to cover workers synthetic insulative clothing, Rg < 10^9 ohms. Smock should be grounded via operator's wrist strap system or ESD footwear / flooring system. When ESD garment is used as part of the wrist strap grounding path, the total system resistance including the person, garment and grounding cord should be less than 3,5 × 10^7 ohms.			
			Area/s:	**In Spec?**
Observation	ESD smocks are part of the ESD Control Program		1	Yes
Measurements	**Result:**	**Comment:**		
	Rp: 4.1 x 10^ 7 ohms		1	Yes
Recommendation	No corrective action required.			
Informational	Wrist Straps reliably remove charges from a person via the moisture layer on their skin; charges on insulative clothing cannot be removed via the Wrist Strap. The primary purpose of ESD Smocks is to shield ESD susceptible items from charges on operators' clothing. It should be part of your ESD Control Plan that all smocks are to be closed and regular clothing does not extend beyond the smock cuff. Otherwise, you are defeating the primary purpose of the ESD smock. For the smock to perform properly, it must make intimate contact with operator's skin, thus grounded when the operator is. A Static Control Garment, that is not grounded, should only be used for those in the ESD protected area who do not handle ESD sensitive items. Good quality smocks will typically measure in the 1 X 10^5 to 1 X 10^6 ohm range when new. There are also smocks that have a designated "operator ground" connection and will allow for the elimination of operator's wristbands as the coil cord can be attached directly to the smock for positive operator grounding and "hands-free" operation.			

3.10	**<u>Tools & equipment</u>** Company to develop their own qualification criteria for handtools		**Area/s:**	**In Spec?**
Observation	Has the company developed their own qualification for Handtools and equipment?	No	1	
		Comments: Non ESD safe tools are used in the ESD Protected Area		
Recommendation	Replace hand tools that have insulative handles with tools that have low charging dissipative handle When re-ordering, specify AC Powered Tools that have ESD protective symbol, and ensure these are specified on your qualified product list.			
Informational	Consider installing a Soldering Tip Voltage Monitor for each soldering station to monitor overvoltage. Use multi-meter to measure path-to-ground by connecting one electrode to conductive end of powered tool (i.e. solder tip) and connect other electrode to equipment ground. Soldering irons, if tips not grounded, can cause EOS [Electrical-Over-Stress] damage to ESD sensitive components. New powered hand tools such as soldering irons typically should have a tip to ground resistance of less < 1 ohm. Note - This resistance may increase with use but can be < 10 ohms for compliance verification purposes. Battery powered and pneumatic hand tools while being held should have a resistance to ground of less than 1 X 10^{12} ohms. Can use a Charged Plate Analyser or Ionisation Test Kit to demonstrate charge decay that an ESD tool or accessory can remove to ground. Place +/- 1,000 volts on the isolated conductive plate, and while the technician is grounded touch tool or accessory to isolated conductive plate.			

4. PACKAGING AND TRANSPORTATION

4.1	**<u>Packaging Inside the ESD protected area</u>** – Low Charging, Dissipative (Rp 1 X 10^4 to <1 X 10^{11}) or Conductive Materials are to be used.			
			Area/s:	**In Spec?**
Observation	Only ESD low charging and/or dissipative materials are used for storing, transporting, and/or packaging of ESD susceptible items within the ESD protected area.		1	Yes
	Closed static shielding bags are used for all transportation and storage of ESD Sensitive items.		1	Yes
Measurements	**Result:**	**Comment:**		
	Rp: 2.9 x 10^ 4 ohms	Measured on conductive black PCB storage	1	
	Rp: 6.9 x 10^ 7 ohms	Static shield bag was measured	1	
Recommendation	Specify material handling, totes, and/or packaging ESD protective packaging marked with the ESD Protective Symbol.			
Informational	Unpackaged ESD susceptible items must be placed directly on grounded ESD worksurfaces or on materials where Rg measures < 1 X 10^9 ohms. An ESD Protected area is where all conductors are grounded. When circuit boards are placed on good quality grounded mats, the conductive elements of the circuit board are effectively grounded. When circuit boards are separated from the matting by shielding bags or other packaging material, grounding is not as effective, and the circuit board conductive components can be isolated from ground. This results in a condition of "isolated" conductors. This can lead to CDM (Charged Device Model) damage to ESD susceptible parts. A basic principle is that ESD susceptible items should only be out of their ESD protective packaging when they are in an ESD protected area. Unpackaged ESD susceptible items should only be handled by a grounded operator in an ESD protected area. Tubes are topically treated to reduce tribocharging of devices sliding in the tube. Their low charging properties are NOT permanent. As such, re-use of tubes should be eliminated. A system to identify tubes that have lost their low charging properties has often been found to not be cost effective. If tubes are to be re-used, a topical treatment program should be evaluated. Additionally, transparent tubes do not provide ESD shielding and should be transported and stored in shielding bags when outside the ESD protected area.			

4.2	**<u>Packaging Outside the ESD Protected Area</u>** - Shielding bags or other shielding containers with covered lid (Faraday Cage) are to be used to transport or store ESD susceptible items outside the ESD protected area. All packaging materials used for outside the ESD protected area must measure 1 X 10^4 to < 1 X 10^{11} ohm Rs AND provide discharge shielding.			
			Area/s:	**In Spec?**
Observation	Closed static shielding bags are used for all transportation and storage of ESD Sensitive items.		1	
Measurements	**Measured 1 X 10^4 to < 1 X 10^{11} Rs (<u>dissipative</u>) on the following ESD shielding containers/packaging items for ESD susceptible devices/assemblies:**			
	Result:	**Comment:**		
	Rs: 3.9 x 10^ 6 ohms	Measured on a static shielding bag	1	yes
Recommendation	No corrective action required.			
Informational				

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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