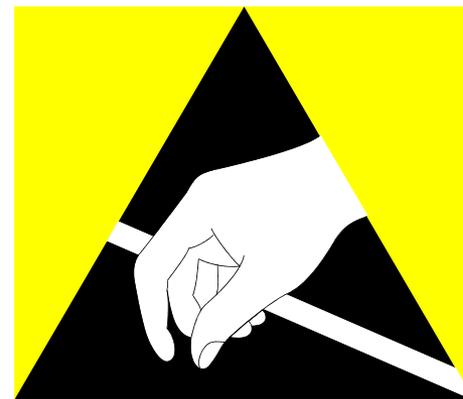
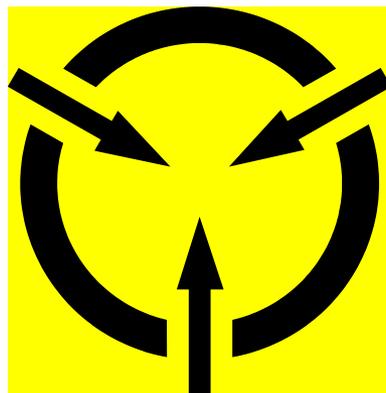
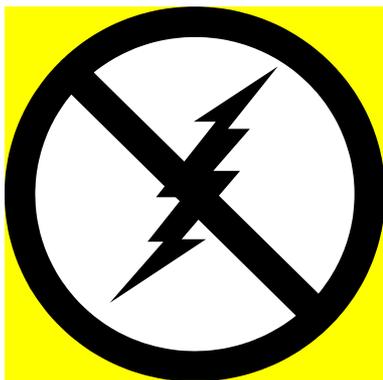




# AIM Solutions Consulting Presents: ESD Protective Measures for Aircraft Disassembly and Distribution Operations





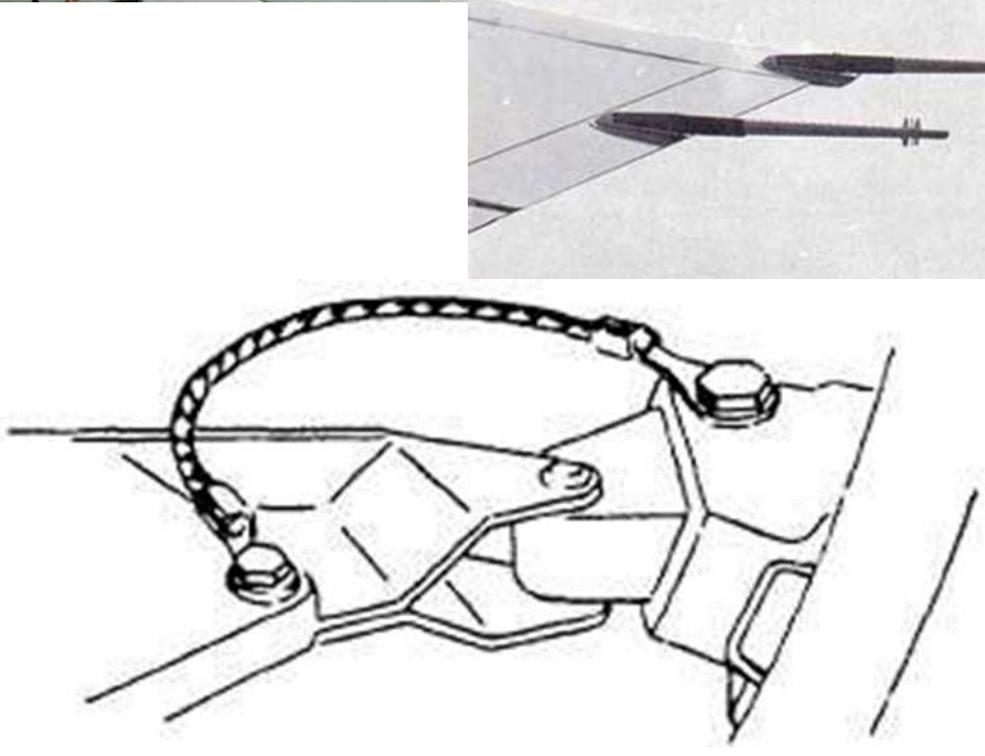
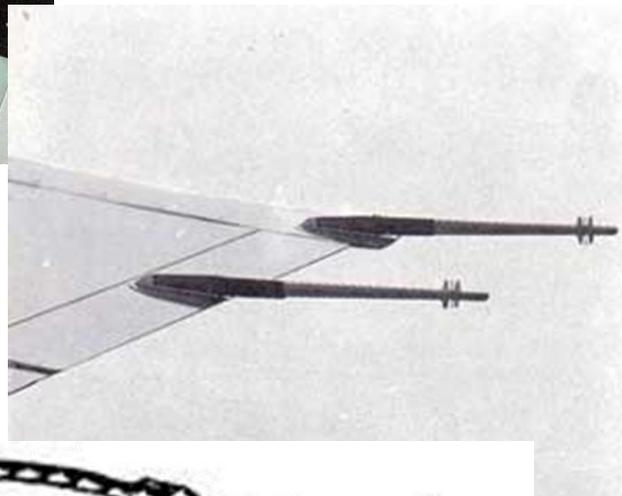
***WARNING: The material in this presentation is general in nature, and under no circumstances is it meant to replace published OEM or Maintenance Manual instructions***



# ***Introduction***



# What do these all have in common?



All are methods to control and manage static



## ***HISTORY AND BACKGROUND***

To many people, static electricity is little more than the shock experienced when touching a metal doorknob after walking across a carpeted room. However, static electricity has been a serious industrial problem for centuries. As early as the 1400's, European and Caribbean forts were using static control procedures and devices to prevent electrostatic discharge ignition of black powder stores. By the 1860's, paper mills throughout the US employed basic grounding, flame ionization techniques, and steam drums to dissipate static electricity from the paper web as it progressed through the drying process.

The age of electronics brought with it new problems associated with static electricity and electrostatic discharge. Due to electronic devices becoming faster and smaller, their sensitivity to ESD increased. Today, ESD impacts productivity and product reliability in virtually every aspect of today's electronics environment.



Ok I give up, what is this  
ESD stuff?



**Static electricity** is defined as an electrical charge caused by an imbalance of electrons on the surface of a material. This imbalance of electrons produces an electric field that can be measured and that can influence the objects at a distance.

**Electrostatic discharge** is defined as the transfer of a charge between bodies at a different potential

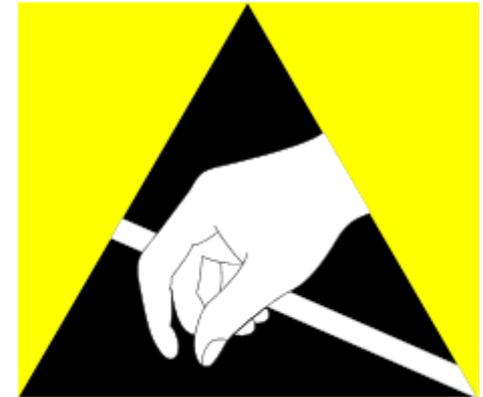


# Electrostatic Sensitive Devices (ESD)

- Although we may not feel it, we built up and discharge electrical charges constantly. A doorknob discharge may involve voltages as high as 10,000 volts! The reason we are not instantly killed by these discharges is because the current flow or amperage is very small.
- There are some electronic components that are especially sensitive to ESD. Remember, to an ESD sensitive part, a discharge is like getting struck by a lightning bolt!



**You'll know positively  
that you have an ESD  
Part when you see one  
of, or a variation of  
these ESD symbols**



You will generally come in contact with 3 types of ESD sensitive parts:

Cards/Boards



Discreet components such as IC Chips

Component Assemblies (LRU's, Rotables)



# About LRUs or Rotables:



## INSTALLED ESD Component's:

You will **NOT**  
induce ESD  
damage by  
merely  
touching them



## About LRU's or rotables:

When ESD Caps are protecting the pins, you can safely handle the LRU without being personally grounded

**Typical ESD Caps**

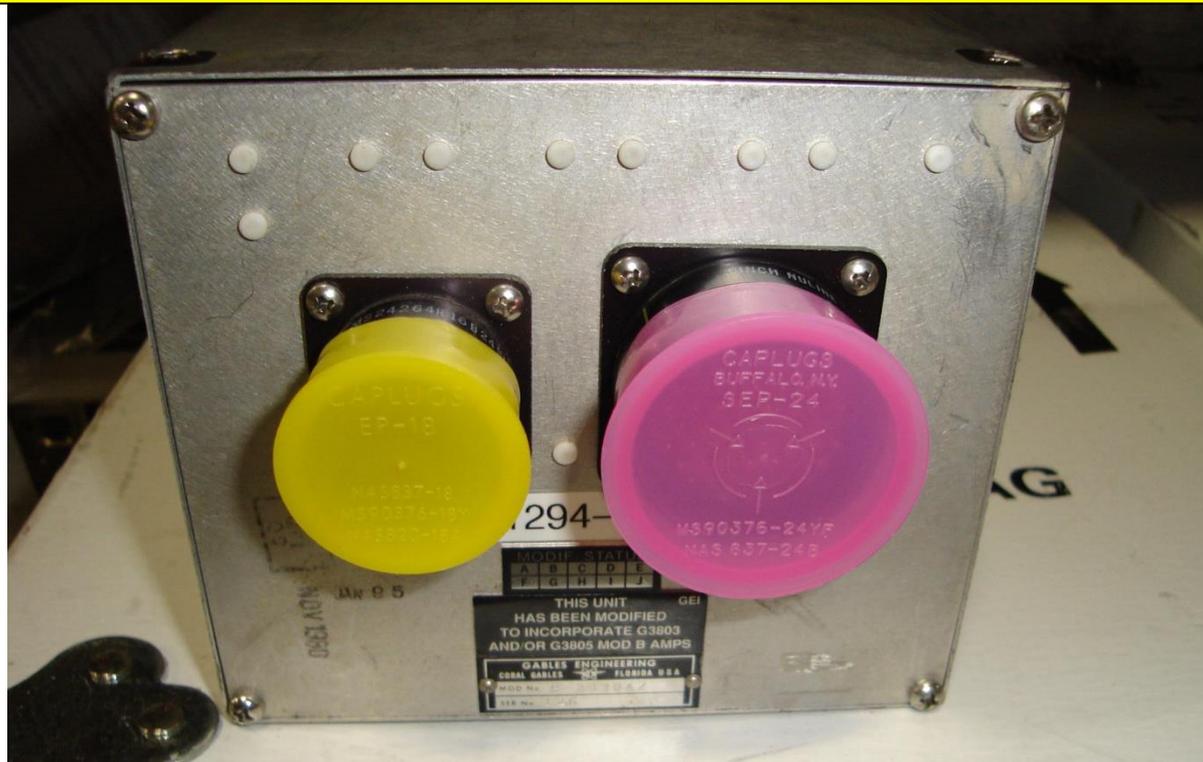




## About LRU's or rotables:

***LRU's are damaged by ESD charges in one of two ways:***

***1) By installing the WRONG cap. The yellow cap is actually a very efficient generator of static charges***





## About LRU's or rotables:

***LRU's are damaged by ESD charges in one of two ways:***

***2) When the protective caps are off, and the pins come in contact with static charges:***

- During installation***
- During removal***
- In storage***
- In transport to and from the aircraft***





***End of:  
Introduction***

***Next:  
Effects of ESD  
Damage***

LED ZEPPELIN

STEREO

What really caused the Hindenburg disaster?  
Was it stray ESD that may have ignited the volatile hydrogen gas?

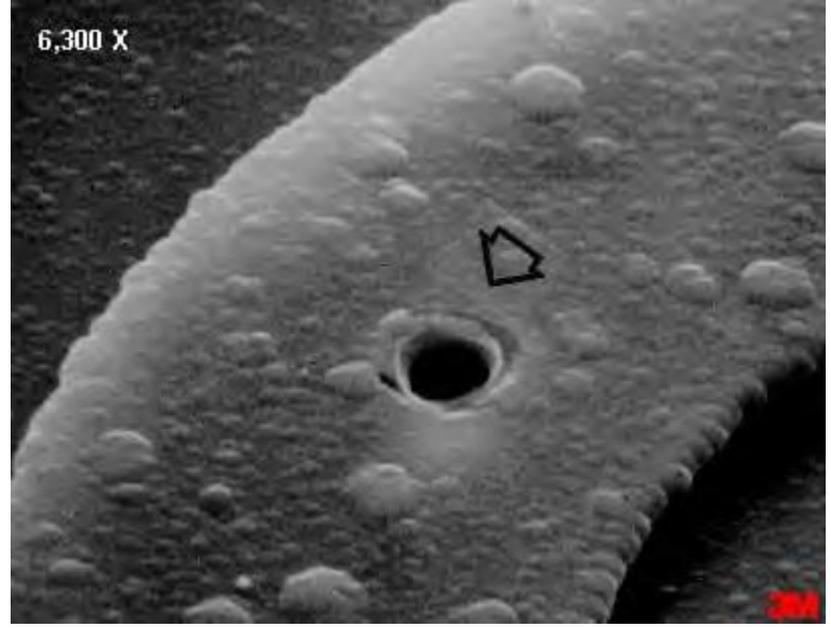
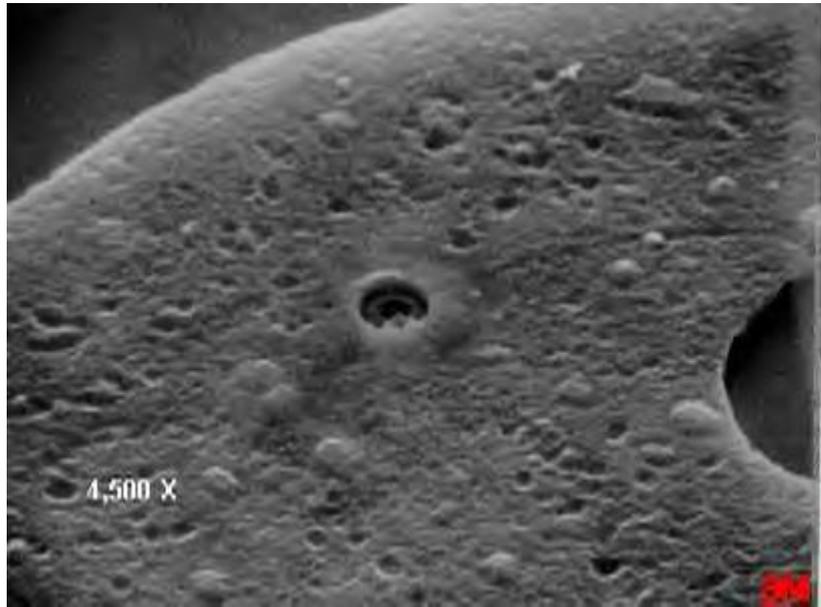
ATLANTIC



I've got the forensic evidence of ESD Damage right here!



**Typical ESD damage. These pictures were taken by scanning electron microscopes. Note the magnification**



But Holmes,  
can the issue of  
ESD damage be  
quantified and  
deduced?

Watson, due to the high  
cost of scanning  
electron microscopes,  
and the complicated  
process to isolate it,  
nearly all instances of  
ESD damage are not  
diagnosed as such; *it is  
unquantified and  
undetected except for  
the failures it causes*





**ESD DAMAGE  
WILL MANIFEST  
ITSELF IN ONE OF  
THREE WAYS:**

**Outright failure of  
the unit upon  
installation**

**Premature Failure:  
It should have  
lasted 1000 hours  
but failed after 50**

**Intermittent failures**



By the way, this is a contributor to those pesky No Fault Found (NFF) findings





***NEXT:***  
***ESD Protection***  
***During Aircraft***  
***Disassembly***  
***Operations***



## **Typical Manufacturer warnings**

From “The Direct Approach, Technical Information & Tips for Citation Customers”

**Epic Handling and ESD Tips- 680**

**ATA 34-00**

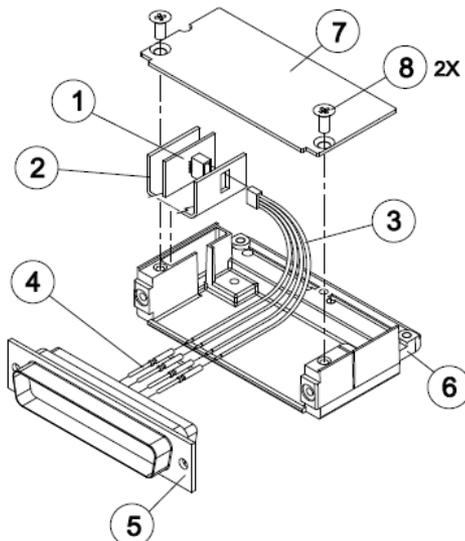
***Honeywell is very concerned that everyone understands how important it is to follow proper ESD (Electro Static Discharge) and handling procedures of Epic hardware.***

**Use Caution with Honeywell KA 92 GPS Antennas**

**560XL, 550, 525, 525A, ATA: 34-40**

***“... Our vendor has requested that we make owners/operators aware that these types of antennas are extremely sensitive to Electrostatic Discharge (ESD). Uncontrolled ESD can cause degraded operation of certain electronic components within the antennas.”***

**For Training and Reference Only**



**Figure 6-3. Configuration Module Installation**

**Typical ESD Warning in a Maintenance Manual**

**Table 6-2. Configuration Module Kit – 011-00979-00**

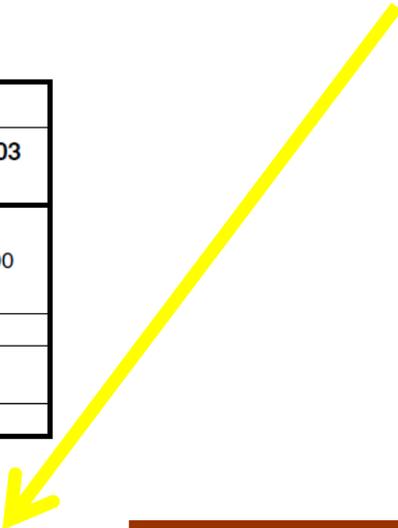
Item	Description	Qty Needed	Garmin Part Number	
			011-00979-00 Kit	011-00979-03 Kit
1	Configuration Module PCB Board Assembly w/EEPROM & Temp Sensor	1	012-00605-00	011-02178-00
2	Spacer, Config Module	1	213-00043-00	N/A
3	Cable, 4-Conductor Harness	1	325-00122-00	
4	Pins, #22 AWG (HD)	5	336-00021-00	

Removal:

**NOTE**

Use ESD protection when handling the configuration module.

1. Disconnect connector from LRU.
2. Remove 2 screws (8) from cover (7) and remove cover.
3. Unplug connector from configuration module (1).
4. Remove configuration module.



***But where might you find the ESD guidance in the AMM?***

**ELECTROSTATIC DISCHARGE SENSITIVE DEVICES - MAINTENANCE PRACTICES**

For Training and Reference Only

**1. General**

(Figure 201)

- A. Many electronic line replaceable units (referred to as LRUs) contain micro-circuits and other sensitive devices which can be damaged internally by electrostatic discharges. These LRUs are identified as Electrostatic Discharge Sensitive (referred to as ESDS). The placards installed on the ESDS LRUs show that you must be careful. The persons who remove, install, and move the ESDS LRUs must know about static electricity and the protection from static discharges that is necessary.
- B. Electrostatic charges can be caused by these: human bodies, hair, clothing, floors, equipment racks, and equipment units. An electrostatic discharge is electrostatic energy transmitted between substances of different electrical potentials. Electrostatic discharges from nylon clothing or human hair onto polyethylene or steel can damage ESDS components. Damage to the internal components of an ESDS LRU can cause failure with one static discharge. System properties can change with time because of many static discharges.
- C. The function of these procedures is to show the maintenance persons how to know and touch the ESDS LRUs. These procedures contain the precautions that are necessary to safely touch the units that are identified by the ESDS placard. Three types of decals are in used to identify the units with ESDS sensitive circuits. The military and commercial symbols are used on some units, while the international (JEDEC) symbol is used on most ESDS placard (Figure 201). The ESDS printed circuit boards that are LRU's are identified with a "STATIC SENSITIVE" placard (Figure 201).
- D. This procedure contains these tasks:
  - (1) ESDS Printed Circuit Board Removal
  - (2) ESDS Printed Circuit Board Installation
  - (3) ESDS Metal Encased Unit Removal Handling
  - (4) ESDS Metal Encased Unit Installation Handling

**TASK 20-41-01-002-001**
**2. ESDS Printed Circuit Board Removal**
**A. Equipment**

- (1) Ohmmeter
- (2) 100% Cotton Twine - Commercially Available

**B. Tools/Equipment**

**NOTE:** When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-1565	Strap - Adjustable Wrist, Conductive, Static Control Part #: 09070 Supplier: 62576 Part #: 14810 Supplier: 62576 Part #: 2214 Supplier: 55203 Opt Part #: 2211 Supplier: 55203 Opt Part #: 2212 Supplier: 55203 Opt Part #: 2213 Supplier: 55203

If you're having trouble finding the guidance for ESD procedures for aircraft work, try ATA Chapter 20 (Standard Practice).

20-41-01

D. Remove the Metal Encased Units with the ESDS Placards

SUBTASK 20-41-01-862-041

 MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

- (1) Remove the system electrical power with the applicable Removal/Installation procedure.

SUBTASK 20-41-01-762-046

 USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS.

- (2) Do these steps to do a test of the static control wrist strap, COM-1565 resistance:

- (a) Use a digital/analog multimeter, COM-1793 to make sure the static control wrist strap, COM-1565 assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.

**NOTE:** A wrist strap is kept on the plenum of the racks E3 and E4 in the main equipment center. (Figure 202)

 THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS METAL ENCASED UNIT.

- (b) Connect the static control wrist strap, COM-1565 on the wrist of the person that will remove the device.
- (c) Use a digital/analog multimeter, COM-1793 to make sure the resistance is less than 10 megohms.

SUBTASK 20-41-01-422-047

- (3) Connect the static control wrist strap, COM-1565 to an applicable electrostatic ground jack.

SUBTASK 20-41-01-022-026

- (4) Remove the ESDS unit with the applicable removal task.

SUBTASK 20-41-01-032-027

- (5) Install conductive dust caps on the connectors that have static sensitive placards, and standard dust caps on the connectors that do not have the placard. An alternate to the dust caps is to put the ESDS unit in a conductive bag.

**NOTE:** The conductive dust caps and the connector covers are black in color.

**NOTE:** The conductive dust caps and the connector covers from the installed unit can be used on the removed unit.

SUBTASK 20-41-01-862-028

- (6) Put the ESDS unit in the antistatic conductive container, COM-1567.

**SAMPLE AMM EXCERPT.  
NOTE THE FOLLOWING:**

- This procedure is for an LRU/Rotable part
- It has you use an ESD wrist strap and cord and have its resistance checked
- Once the part is removed, install the ESD Cap and place it in an ESD bag

**For Training and Reference Only**

# JEOPARDY!

[www.jeopardy.com](http://www.jeopardy.com)

**ANSWER:**

**ESD wrist-strap/cords have a built-in resistance, typically 1 Meg-Ohm to prevent this**



***In case you're working on equipment with live voltages, you don't want to be a direct short to ground; an easy electrocution!***





But what should I do if I don't have the applicable AMM (Aircraft Maintenance Manual) ESD Guidance during my disassembly?



## About Working the Aircraft:



## GOOD PROTECTION



***Make sure power is off and:***

***Put on your ESD Wrist-Strap chord with an alligator clip at the end.***

***Find a good ground (typically structure) and clip it.***

***Perform your removal***

***Cap and bag it immediately***

BTW: How can you verify you have a good ground?

***USE AN OHMMETER TO CHECK FOR CONTINUITY BETWEEN ANOTHER GROUND/STRUCTURE AND THE ONE YOU'VE CHOSEN***

**About Working the Aircraft:**



And PLEASE, if you don't have any ESD caps, put it in an ESD bag!



## About Working the Aircraft:

If you do not have any ESD caps, do not use ESD tape to cover the connector.

From the ASA-100 paragraph 11.B.2):

### WARNING

TAPE SHALL NOT BE USED TO COVER ELECTRICAL CONNECTIONS OR FLUID FITTINGS/OPENINGS. ADHESIVE RESIDUE CAN INSULATE ELECTRICAL CONNECTIONS AND CONTAMINATE HYDRAULIC OR FUEL UNITS.





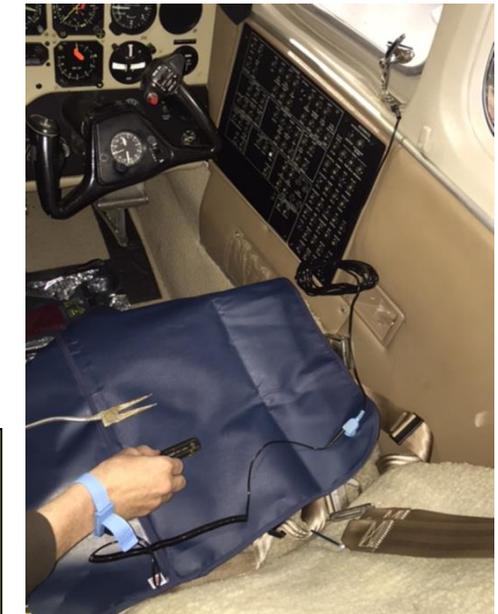
***Next:***  
***Introduction to the***  
***ASA's ESD Best***  
***Practice Document***



***For Persons involved in manufacturing or Aircraft Maintenance, there are a multitude of ESD Standards and Procedures, for example:***



***ANSI/ESD S20.20, "Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)"***  
***MIL-DTL-117, "Bags, Sleeves and Tubing – Interior Packaging"***  
***MIL-PRF-81705, "Electronic and Electrical Equipment, Accessories, and Provisional Items (Repair parts): Packaging of"***  
***MIL-STD-1686, "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)"***  
***MIL-HDBK-263, "Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic parts, Assemblies, and Equipment (Excluding Electrically-Initiated Explosive Devices)"***  
***MIL-PRF-87893, "Workstations, Electrostatic Discharge (ESD) Control"***



***For Distributors not involved in Manufacturing or Maintenance, these standards created dizzying, confused options for ESD Protection***





PSB Singapore

# CERTIFICATE

The Certification Body  
of TÜV SÜD PSB Pte Ltd

certifies that



ASE GROUP  
**ASE ELECTRONICS (M) SDN BHD**  
Plot 20, Phase 4,  
Bayan Lepas Free Industrial Zone,  
11900, Bayan Lepas,  
Pulau Pinang  
Malaysia

has established and applies  
an Electrostatic Discharge Control Program for

**Wafer Sorting, Assembly and Testing of Semiconductor Devices**  
(See Appendix to Certificate for Details)

Proof has been furnished that the requirements  
according to

**ANSI/ESD S20.20 : 2014**

(Lead Assessor : Low Teng Leng)

are fulfilled. The certificate is valid from **2020-01-15 to 2021-02-01**  
Certificate Registration No. **ESD-2018-0015**  
Date of Print : **2020-01-16**



CHUAH Choo Huat  
Vice President  
Business Assurance Division  
Management Systems



Page 1 of 2

Please refer to [www.tuv-sud-psb.sg](http://www.tuv-sud-psb.sg) for current certificate status in the "Directory of Management System Certified Companies".

***In Fact there are  
ESD Standards  
whereby you'll  
be audited and  
become  
accredited,  
similar to ASA  
and ISO  
accreditation  
programs***

ZERTIFIKAT ♦ CERTIFICATE ♦ 認證證書 ♦ СЕРТИФИКАТ ♦ CERTIFICADO ♦ CERTIFICAT



**ASA Best Practice**  
**Handling of ESD Sensitive Parts for Distributors**

Published: 9/11/2022

Revision: 3

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***SO, WHAT CAN  
DISTRIBUTORS  
DO?***

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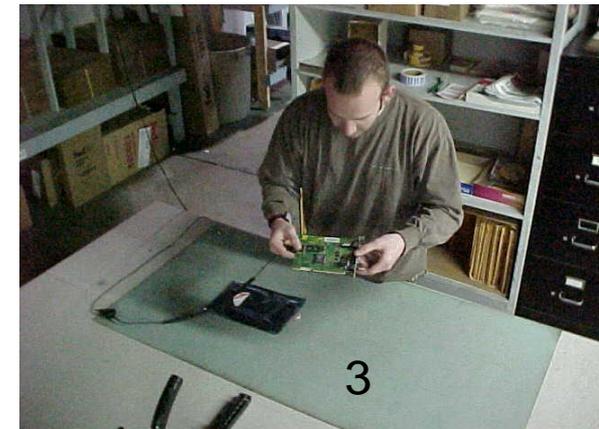
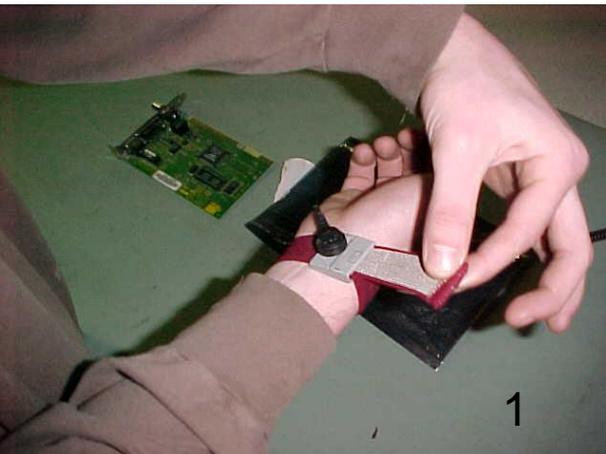
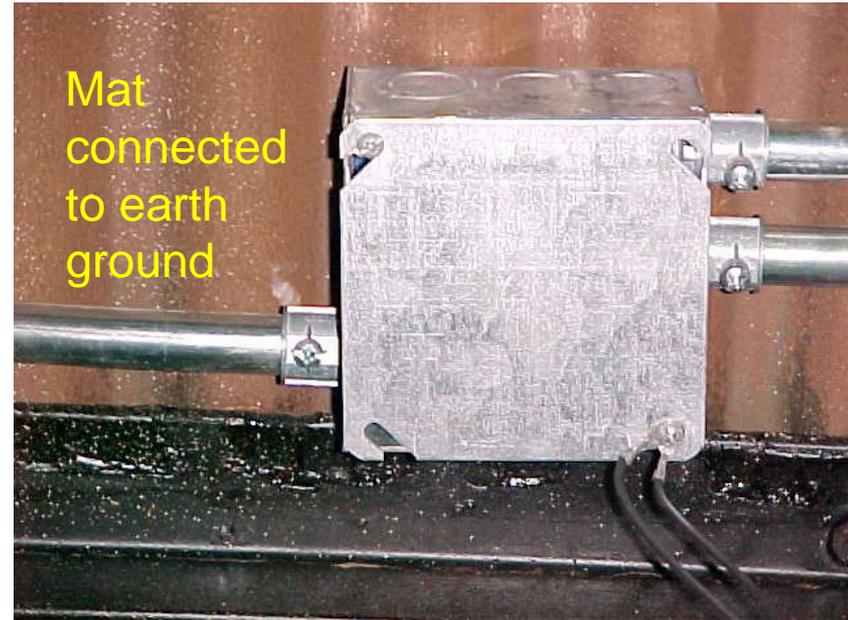
***Notice the  
topics  
addressed in  
this document***

***Essentially, there are two types of ESD Inspection Stations a distributor may chose from:***

***A)A simple station with a wrist strap and cord tester, or***

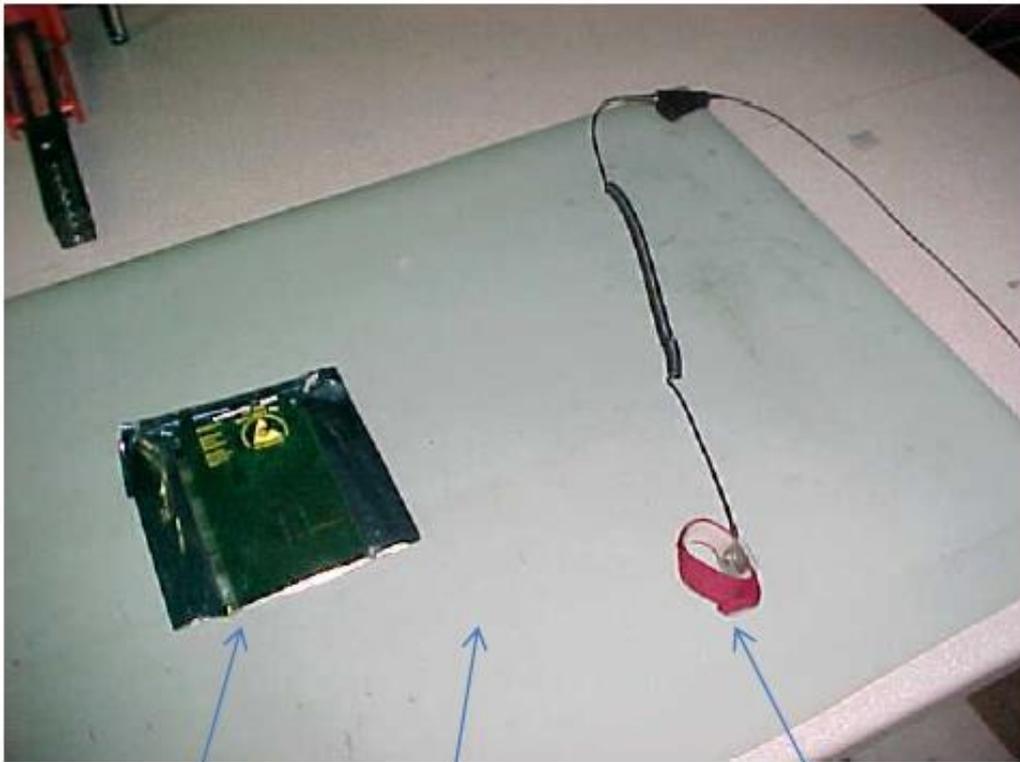
***B)A station with continuous monitoring***

# A TYPICAL ESD SIMPLE STATION



# Selection of Equipment for an ESD Protected Area (EPA)

Figure 1: Typical Simple EPA

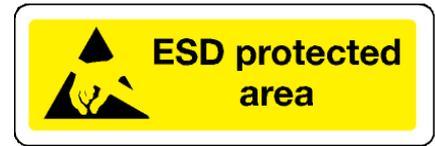


Part to be inspected

ESD Mat

ESD Wrist Strap and chord

To Ground,  
See figure 2



“B. Simple EPA (Figure 1). Consists of an ESD Wrist Strap and chord, Wrist Band Chords, grounding connection, and Table-top conductive/Dissipative Work Surface Mat. “

**BTW: For the Simple EPA Setup, the wrist-strap/Chord combination seems to be the weak link in the ESD protection chain. A common method to check for its integrity might include this tester:**



**Causes of Wrist-strap-chord failures:**

- Loss of elasticity-tightness
- Dirty
- Oxidation on connections
- Hair or dirt on the human



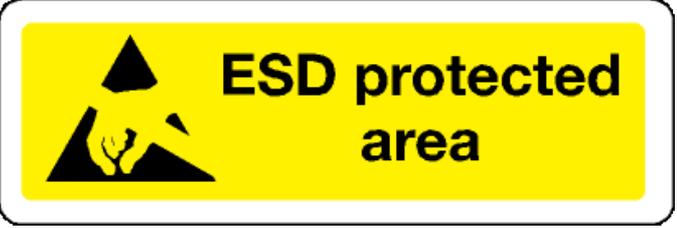
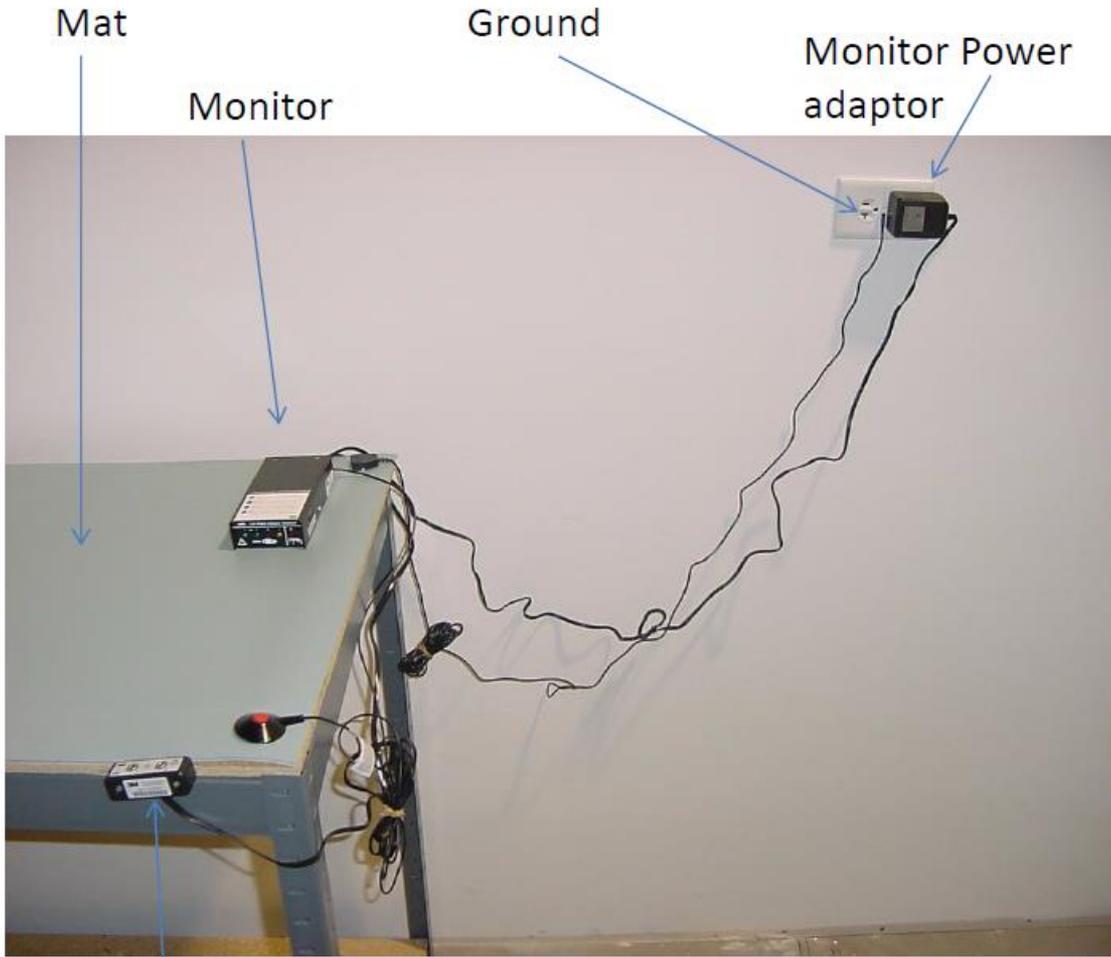
About those floor mats some of you are using with your Simple ESD Station:

- 1) **The ASA Best Practice *does not* require them**
- 2) While it adds another layer of protection, they are not as effective as you might think for the following reasons:
  - Your shoes are actually very good insulators and will not ground your body's static charges unless:
    - You wear these which touch your body and connect directly to the mat bypassing your shoe's insulation:





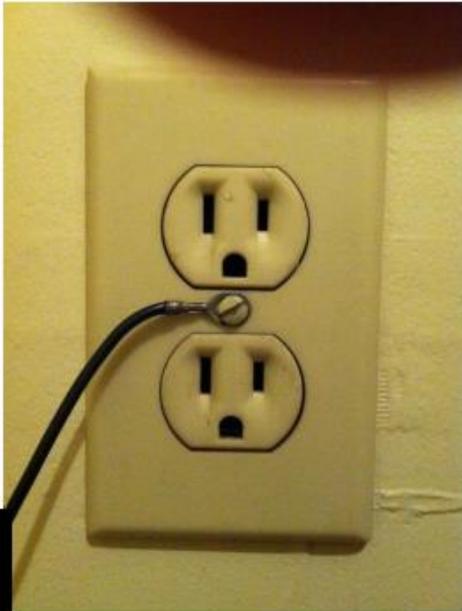
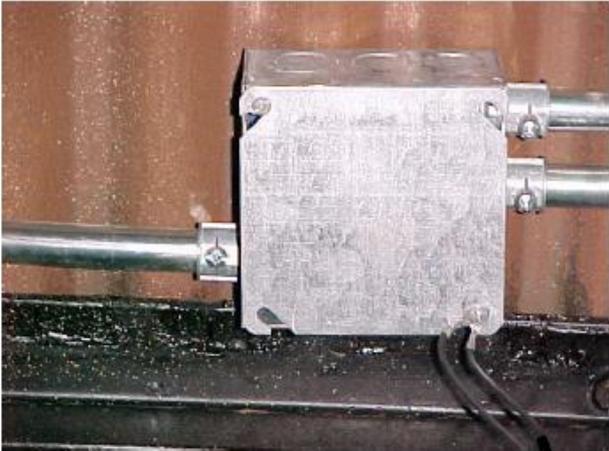
# A Continuous Monitoring Station



**“A. Continuous Monitoring Workstation** (Figure 3). The advantage of this setup is that it **continuously monitors** the resistance of the operator and work surface ground connections **and displays a visual and/or audible alarm if a problem occurs** with the aforementioned. It typically consists of the Monitor, Dual Conductor Wrist Bands, Wrist Band Chords, grounding connection, and Table-top Conductive/Dissipative Work Surface Mat. “

Dual Conductor wrist strap chord plugs-in here

# Selection of a Ground for an ESD Protected Area (EPA)



From Mat

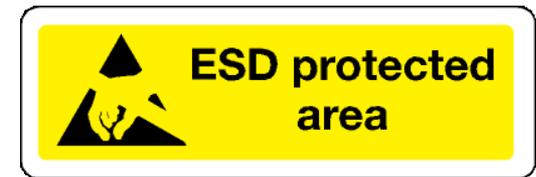


***BTW: Need some terminal solutions? Go to your local automotive shop a buy a cheap Wire Crimp Kit similar to the one shown***





## Common EPA Characteristics



“A. Segregated area: **A dedicated area should be set aside to set up the EPA to be used exclusively for this purpose.** This will help ensure the equipment is maintained, kept clean, and the connections are not broken.

B. The **EPA should include signage** denoting its intended use. Examples include “ESD Protected Area”, “ESD Work Station”, or “ESD Inspection Area”.

C. Cleanliness: **In order to eliminate sources of static, the EPA should remain free of any non-EPA related items such as, but not limited to coffee cups, food wrappers, beverages, reading material, radio’s, and personal gear such as purses and backpacks. In addition, the EPA should be periodically cleaned as recommended by the ESD equipment manufacturer. “**



***End of:***

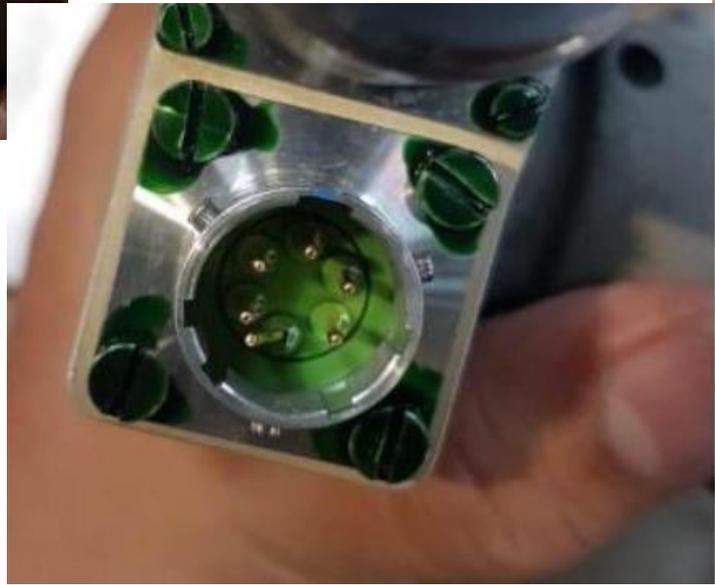
***ESD Inspection Station setup***

***Next:***

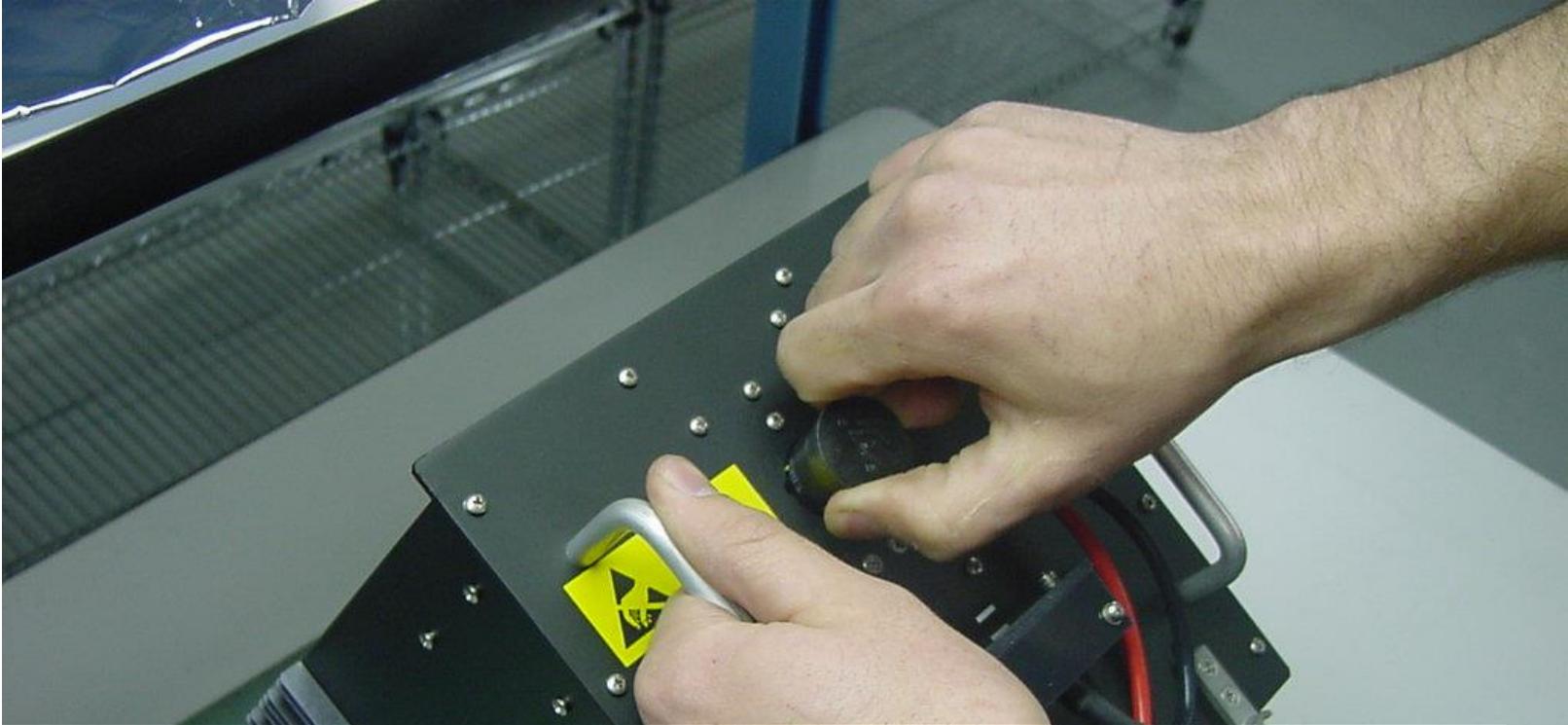
***Handling and Visual  
Inspection of ESD Parts***

**About Components:**

***By the way, it is strongly recommended that when performing a visual inspection, you look under those caps!***



## About Components:



*It is desirable to remove a cap to inspect the connector for:*

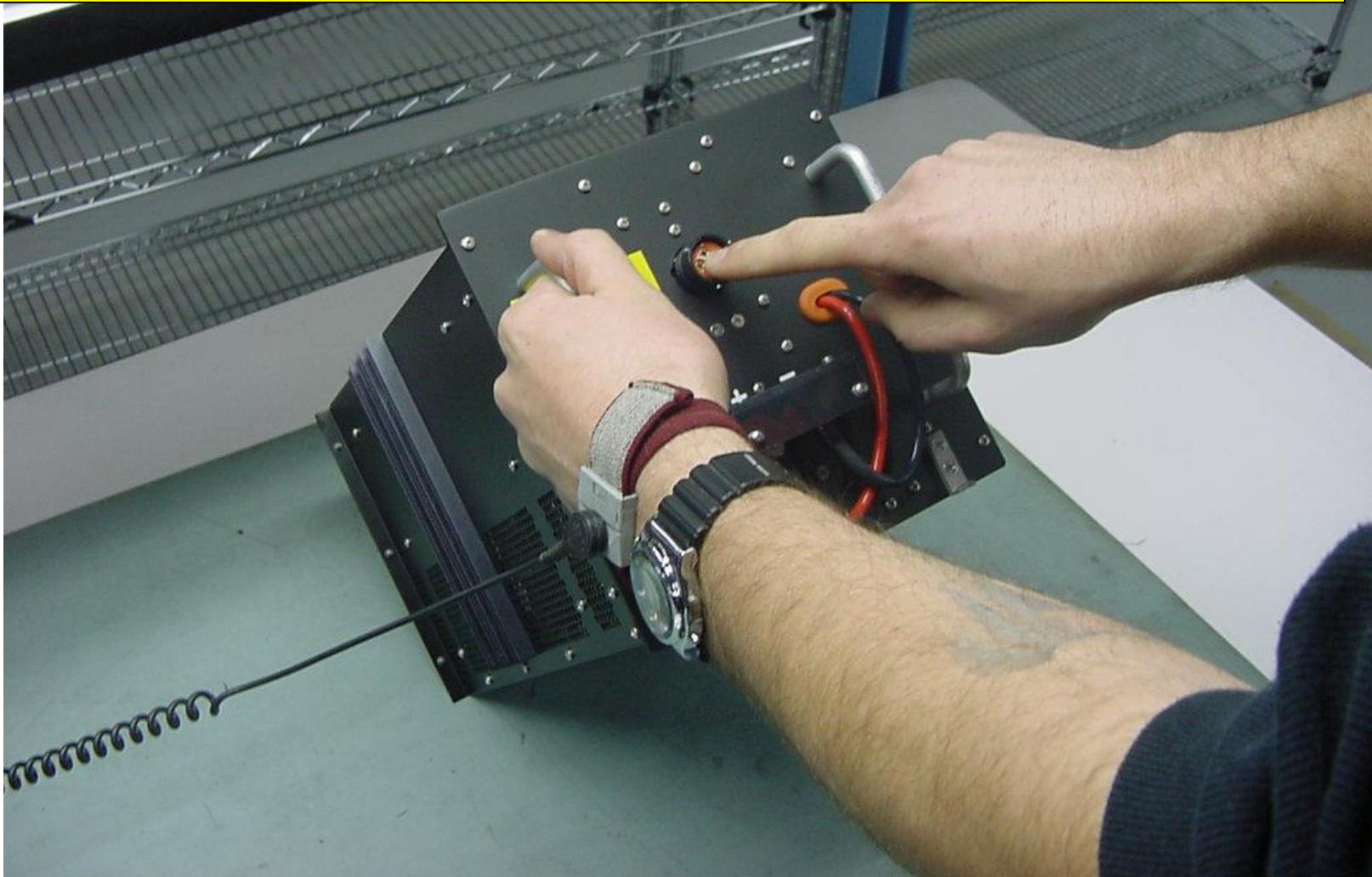
- *Missing pins*
- *Bent pins*
- *Corroded pins*

*In this case, you **MUST** be properly protected*

**About Components:**



***You can now safely touch the connector, or handle an IC Chip, or PC Board***





***Next:  
Packaging***

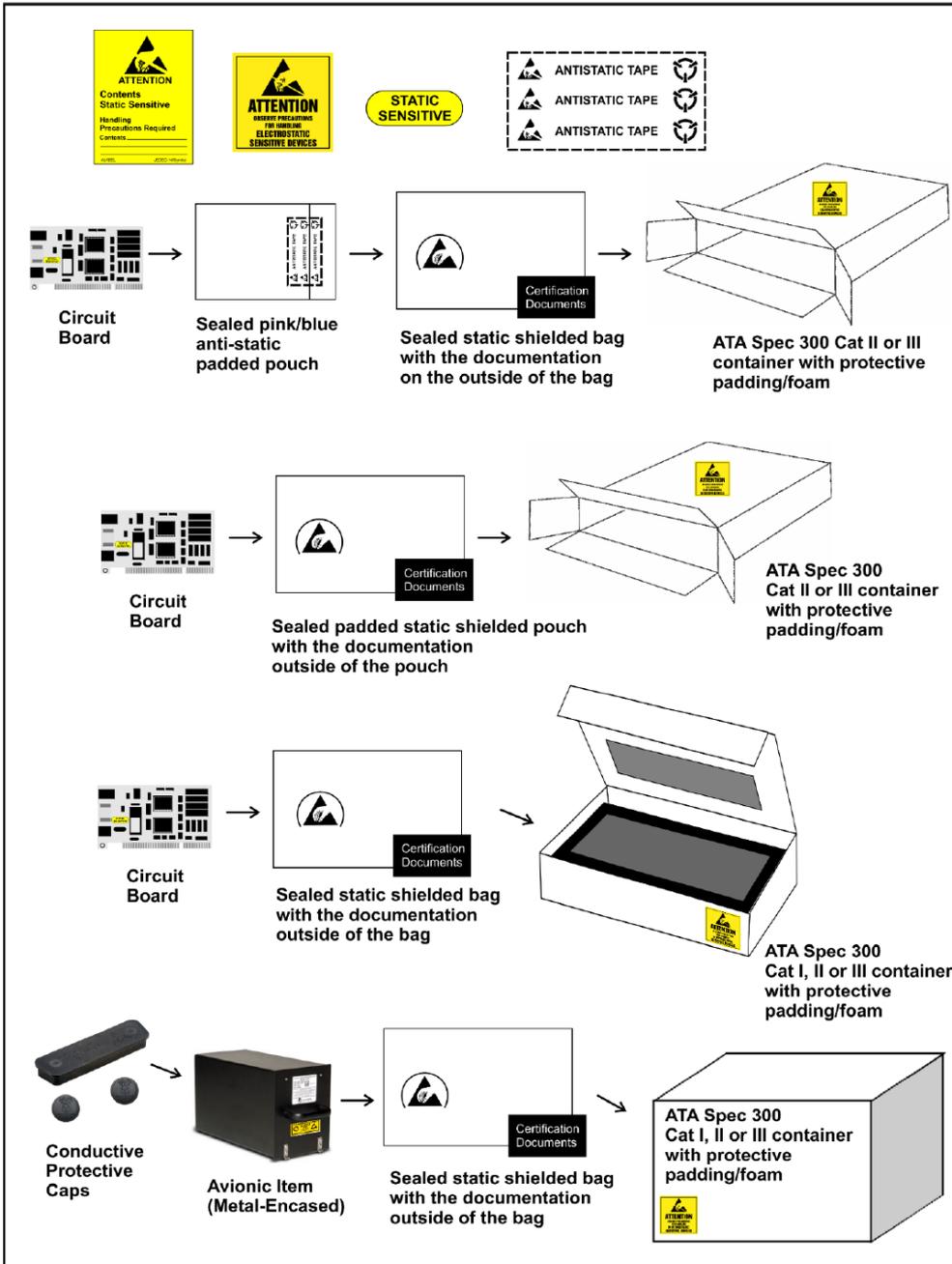
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## **Packaging:**

“When packaging ESD sensitive parts, consideration is given to one of three types of parts; Piece parts (such as IC Chips, Transistors), Circuit Boards, or LRU’s (Line Replaceable Units, commonly referred to as Rotables). ATA Specification 300 offers simple additional guidance.”

Figure 6-2.1. Packaging of Electrostatic Discharge Sensitive Devices



**ESD Packaging: A common standard is ATA Specification 300**



Roy Resto is an experienced aviation industry professional having served in management positions with several firms, and is currently President of AIM Consulting Solutions. Most recently he was Vice President of Technical Operations for Tracer Corp. and Messier-Bugatti-Tracer, a family of aviation companies. Prior to this position, he was the COO of Quality Management Solutions LP, a consulting firm specializing in aircraft maintenance. In addition, Roy worked with American Airlines in their Maintenance and Engineering center where he retired as a level 5 Manager, and before that, with McDonnell Douglas. He was also a member of the US Air Force in the Reserves/ANG having served 32 years in Electronic Warfare and Avionics. Resto has served on the FAA's Suspected Unapproved Parts Steering Committee and the Aviation Suppliers Association Board of Directors.



Roy has an MBA in Finance from Oklahoma City University, a BS from Oklahoma State University, an AAS in Avionics from the Community College of the Air Force, and is an Aviation High School graduate. Complementing these, he has an FAA A&P license, an FCC Radiotelephone license with a RADAR endorsement, is an FAA DAR (Designated Airworthiness Representative), Instrument Rated Pilot, and speaks fluent Spanish. His website is: [www.AimSolutionsConsulting.com](http://www.AimSolutionsConsulting.com)  
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