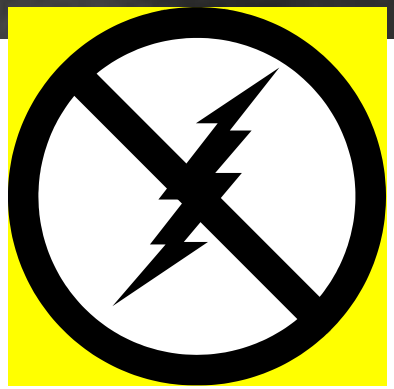
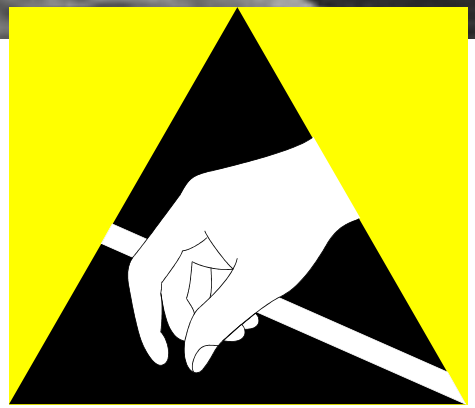
ESD: THE SHOCKING TRUTH!

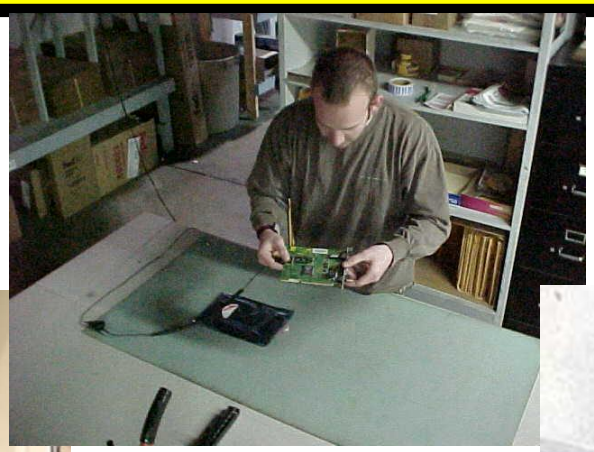


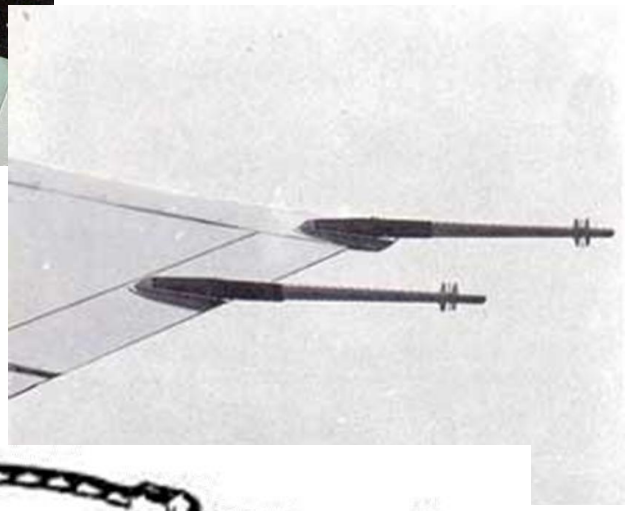


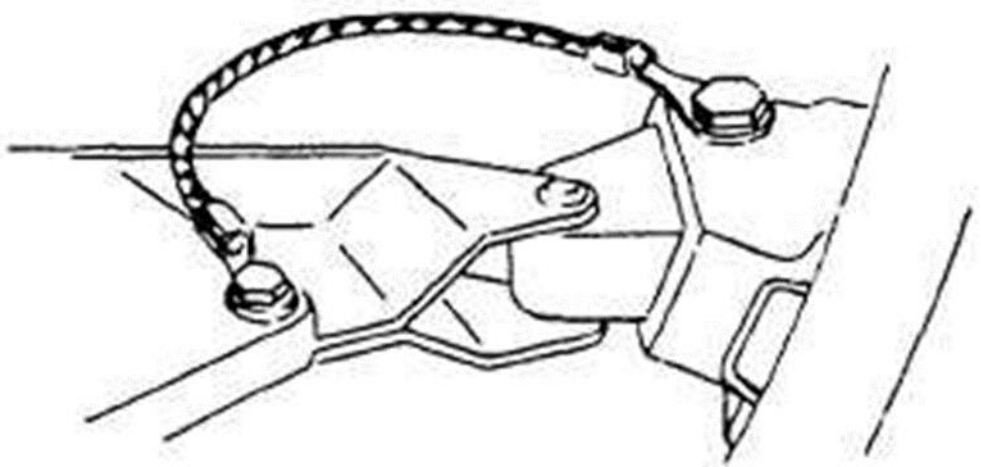
Introduction

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

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!

Despite a great deal of effort during the past decade, ESD still affects production yields, manufacturing costs, product quality, product reliability (as in Avionics), and profitability. Industry experts have estimated **average product losses due to static to range from 8-33% (table 1). Others estimate the actual cost of ESD damage to the industry as running in the billions of dollars annually.**

Table 1
Informal Summary of
Static Losses by Level

Static Losses Reported			
Description	**Min. Loss**	**Max. Loss**	**Est. Avg. Loss**
Component Manufacturers	4%	97%	16-22%
Subcontractors	3%	70%	9-15%
Contractors	2%	35%	8-14%
User	5%	70%	27-33%

Source: Stephen Halperin, "Guidelines for Static Control Management," Eurostat, 1990.

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."

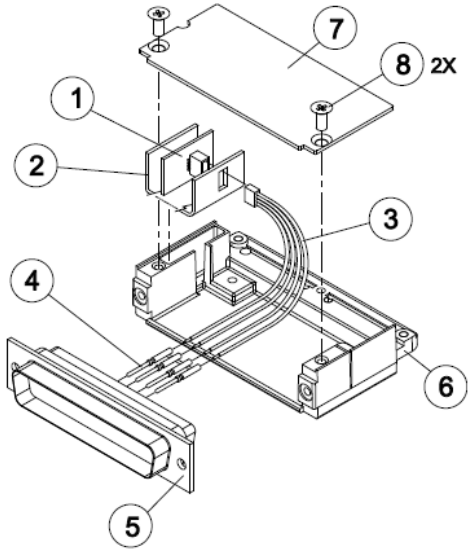


Figure 6-3. Configuration Module Installation

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.

Typical ESD Warning in a Maintenance Manual (Garmin 1000 for Diamond DA-40)

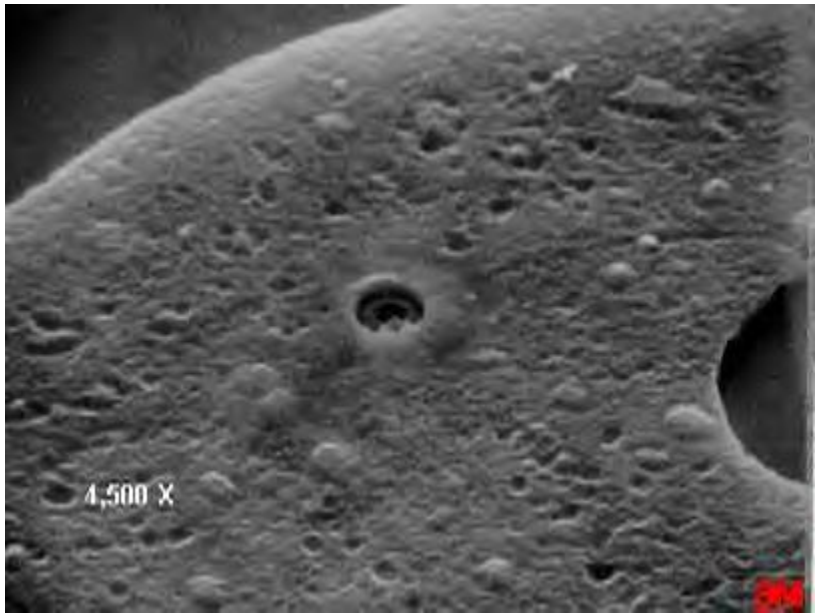
End of: Introduction

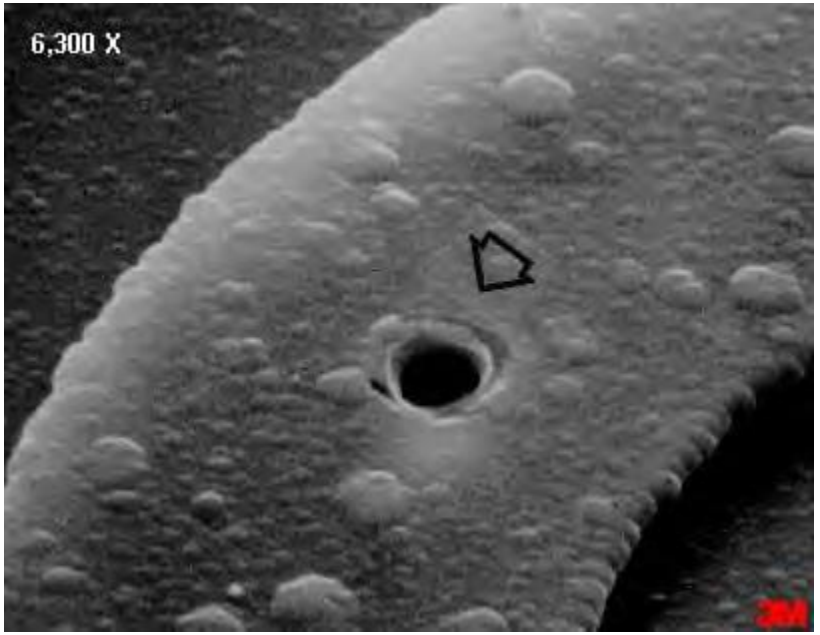
Next: Effects of ESD Damage


LED ZEPPELIN
STEREO
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

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

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

Intermittent failures

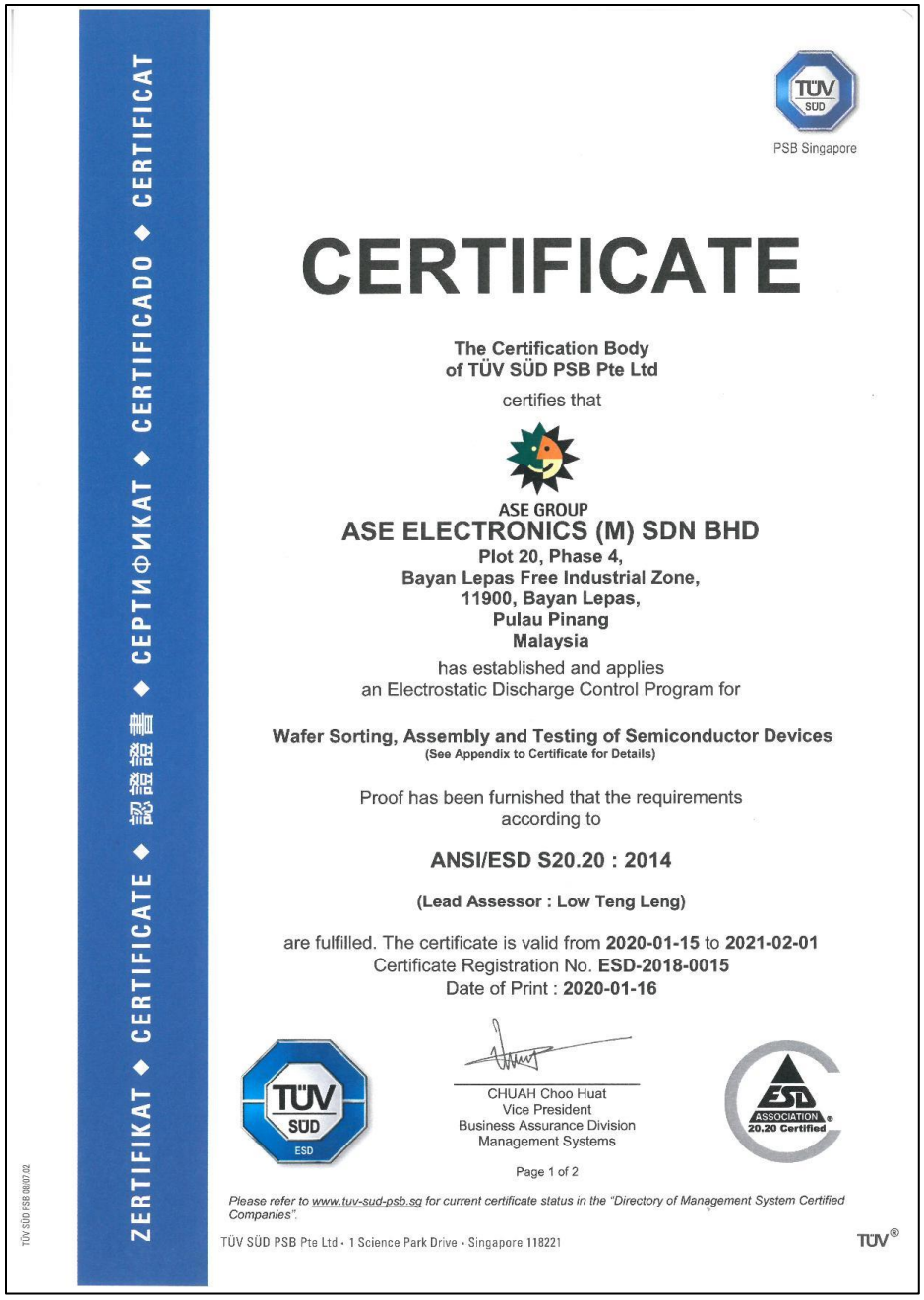
End of:
Effects of ESD Damage

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



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

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 for current certificate status in the "Directory of Management System Certified Companies".

TÜV SÜD PSB Pte Ltd · 1 Science Park Drive · Singapore 118221

TÜV®

TÜV SÜD PSB 08/07.02

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

ASA Best Practice
Handling of ESD Sensitive Parts for Distributors

Published: 3 August 2020

Revision: 2

SO, WHAT CAN DISTRIBUTORS DO?

TABLE OF CONTENTS

Excerpts from this BP will be included in the remainder of this Course

End of:
Introduction to the ASA's ESD Best Practice Document

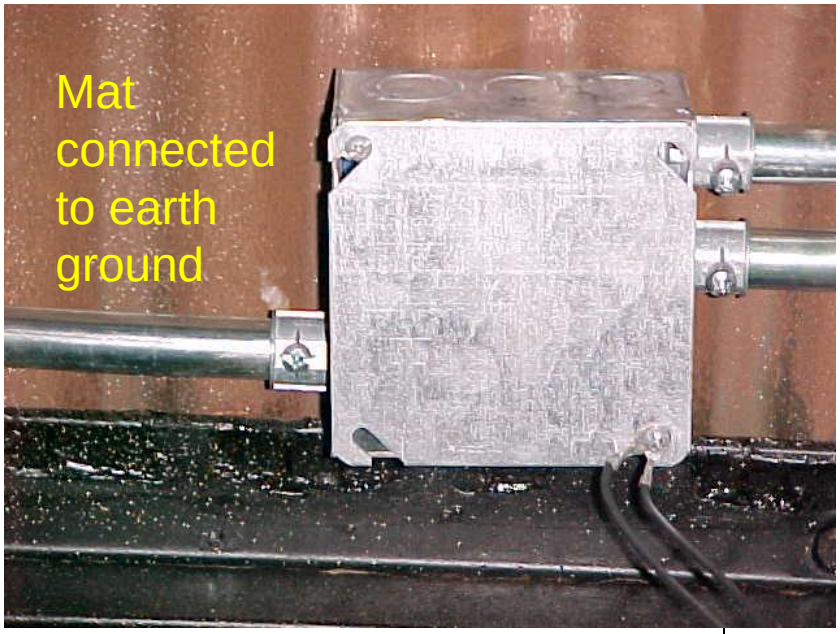
Next:
ESD Inspection Station setup *(with excerpts from the ESD Best Practice)*

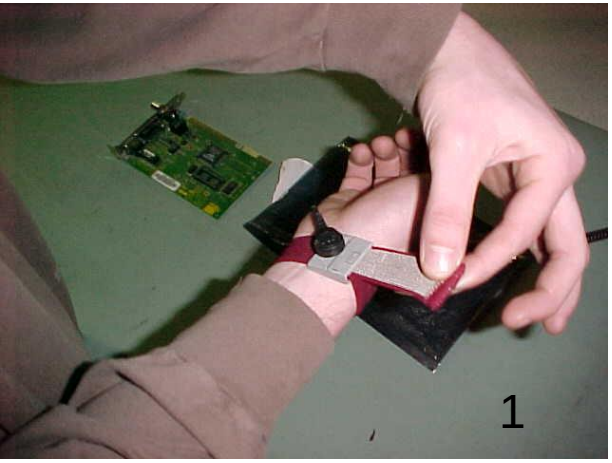
Essentially, there are two types of ESD Inspection Stations a distributor may chose from:

A) A simple station <u>with</u> a wrist strap and cord tester, or

B) A station with continuous monitoring

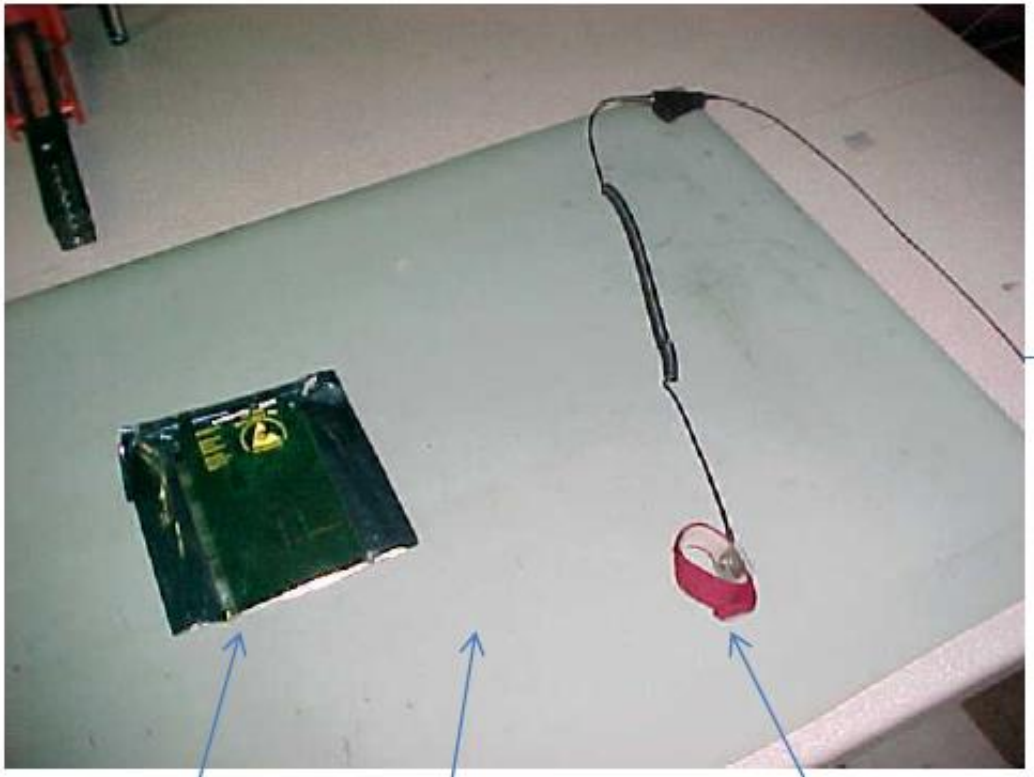
A TYPICAL ESD SIMPLE STATION



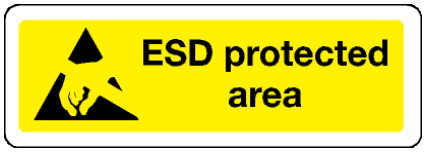


Selection of Equipment for an ESD Protected Area (EPA)

Figure 1: Typical Simple EPA



To Ground,
See figure 2



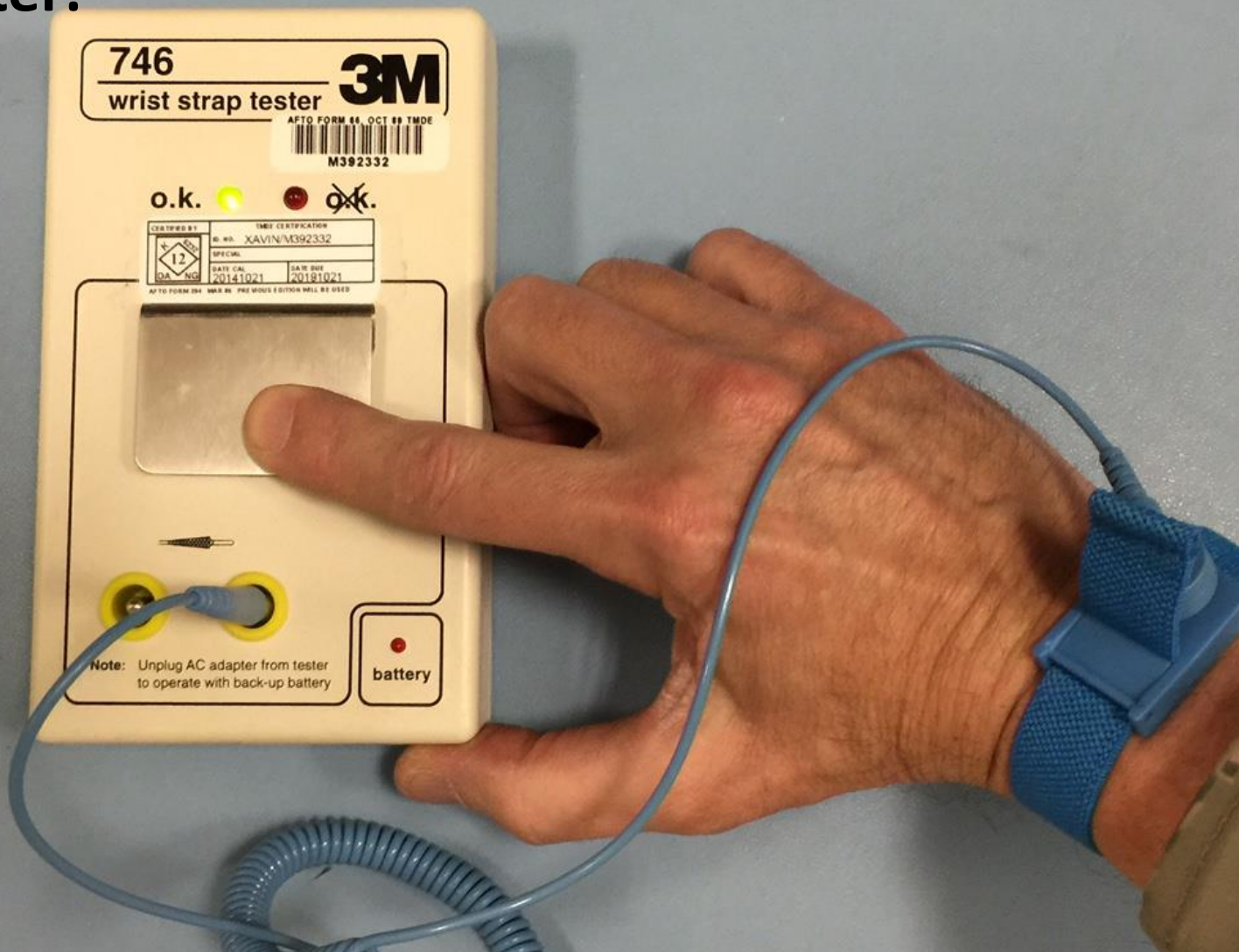
Part to be inspected

ESD Mat

ESD Wrist Strap and chord

"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 <u>Simple EPA Setup</u>, 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

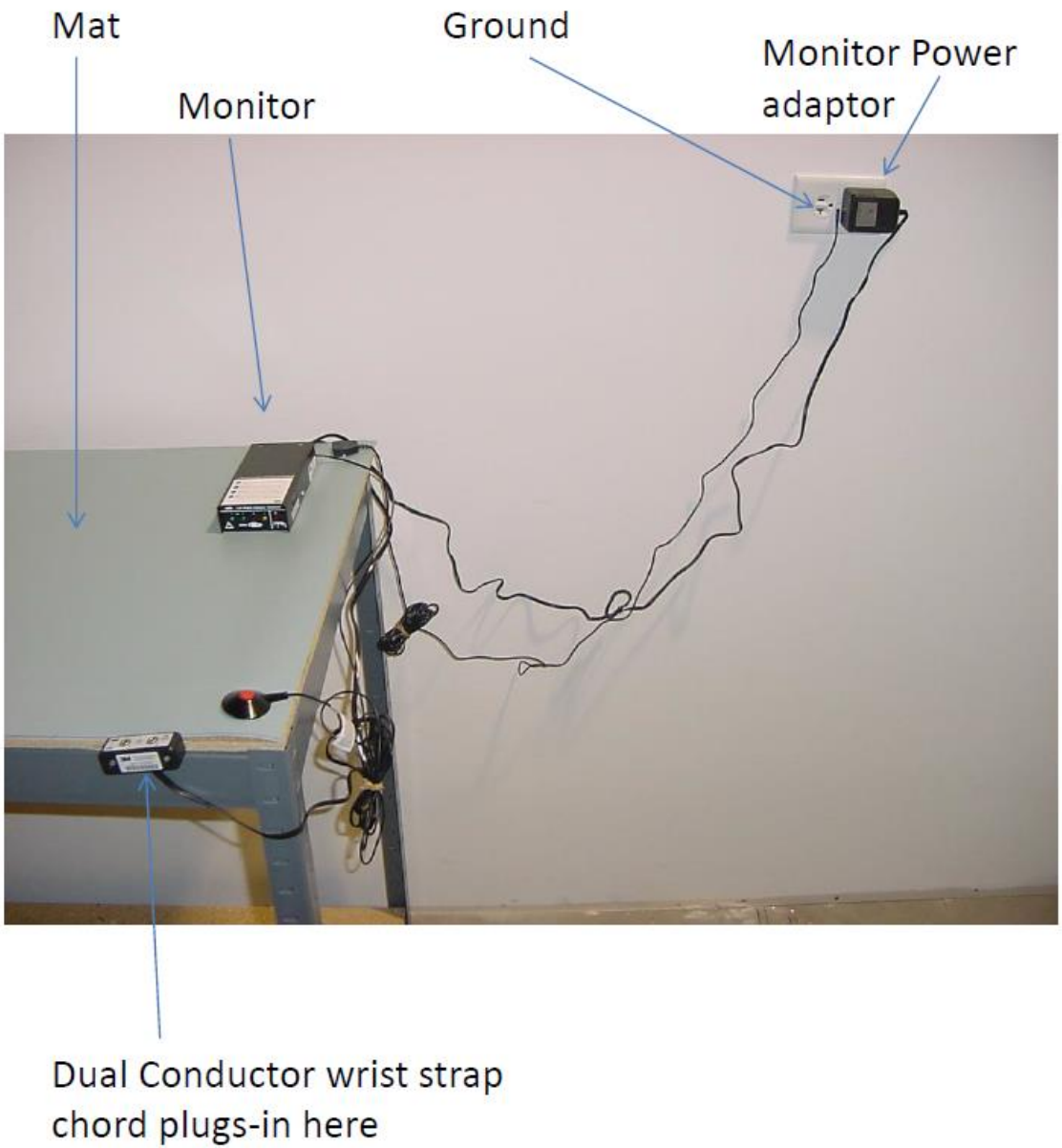
ESD WRIST STRAP TESTING LOG

USER NAME	DATE	TIME	RESULTS
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL
			PASS FAIL

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

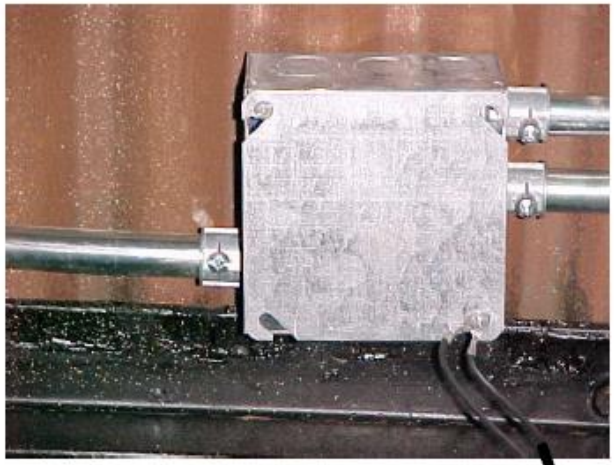
1) The ASA Best Practice *does not* require them
2) While it adds another layer of protection, they are not as effective as you might think for the following reasons:
   - Your shoes are actually very good insulators and will not ground your body's static charges unless:
   - You wear these which touch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

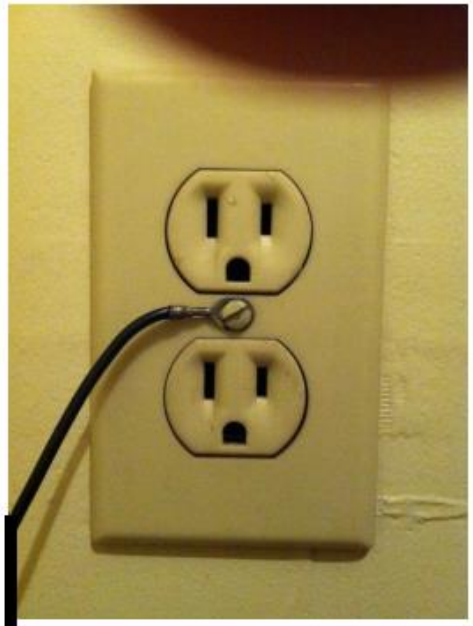
A Continuous Monitoring Station

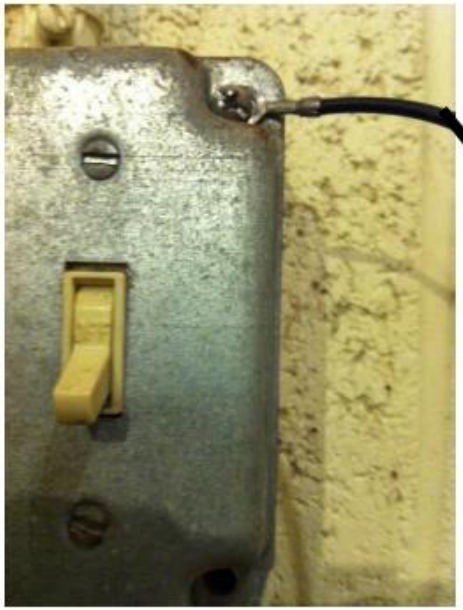


"**A. Continuous Monitoring Workstation** (Figure 3). The advantage of this setup is that it **continuously monitors** the resistance of the operator and work surface ground connections **and displays a visual and/or audible alarm if a problem occurs** with the aforementioned. It typically consists of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

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





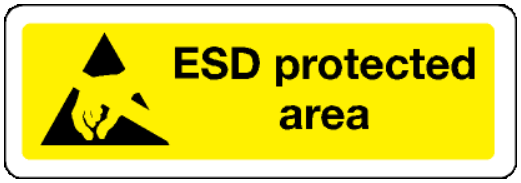


From Mat

"D. Selection of a ground for the EPA must be in accordance with the manufacturer's instructions. "

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



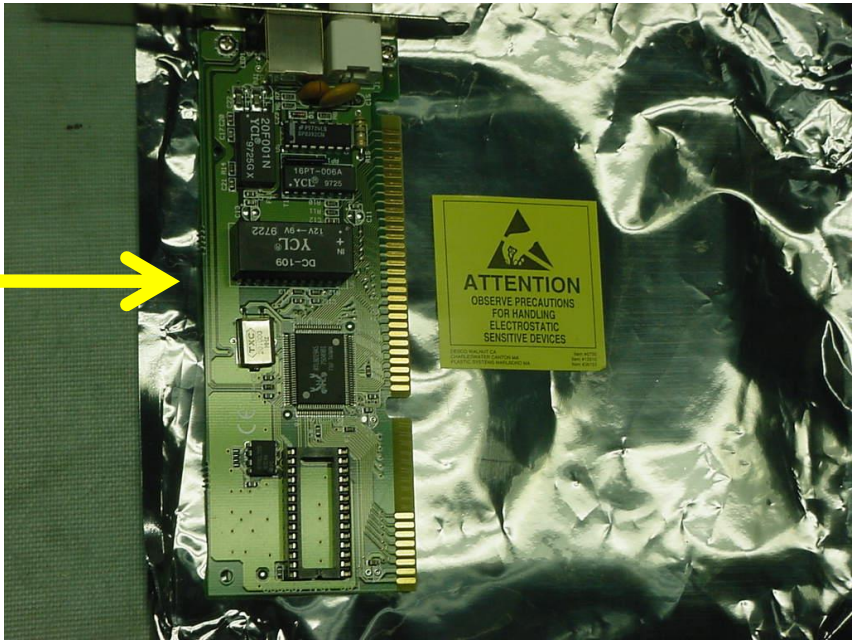
"A. Segregated area: A dedicated area should be set aside to set up the EPA to be used exclusively for this purpose. This will help ensure the equipment is maintained, kept clean, and the connections are not broken.

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. "**

As Distributors, 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)

JEOPARDY!

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!

End of:
ESD Inspection Station setup

Next:
Handling and Visual Inspection of ESD Parts

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

About Component Assemblies:

INSTALLED ESD Component's:

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

About LRU's:

LRU's in Storage or on the Shelf:

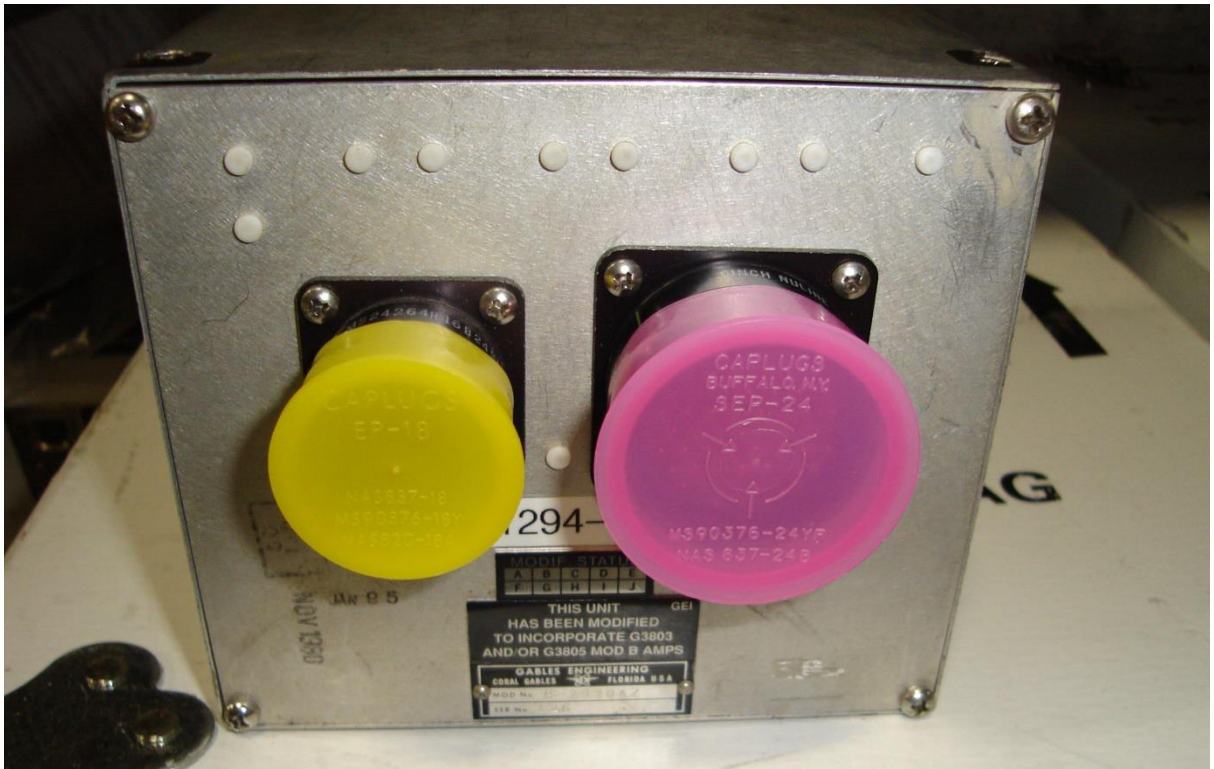
When ESD Caps are protecting the pins, you can safely handle the LRU

Typical ESD Caps

About LRU's:

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

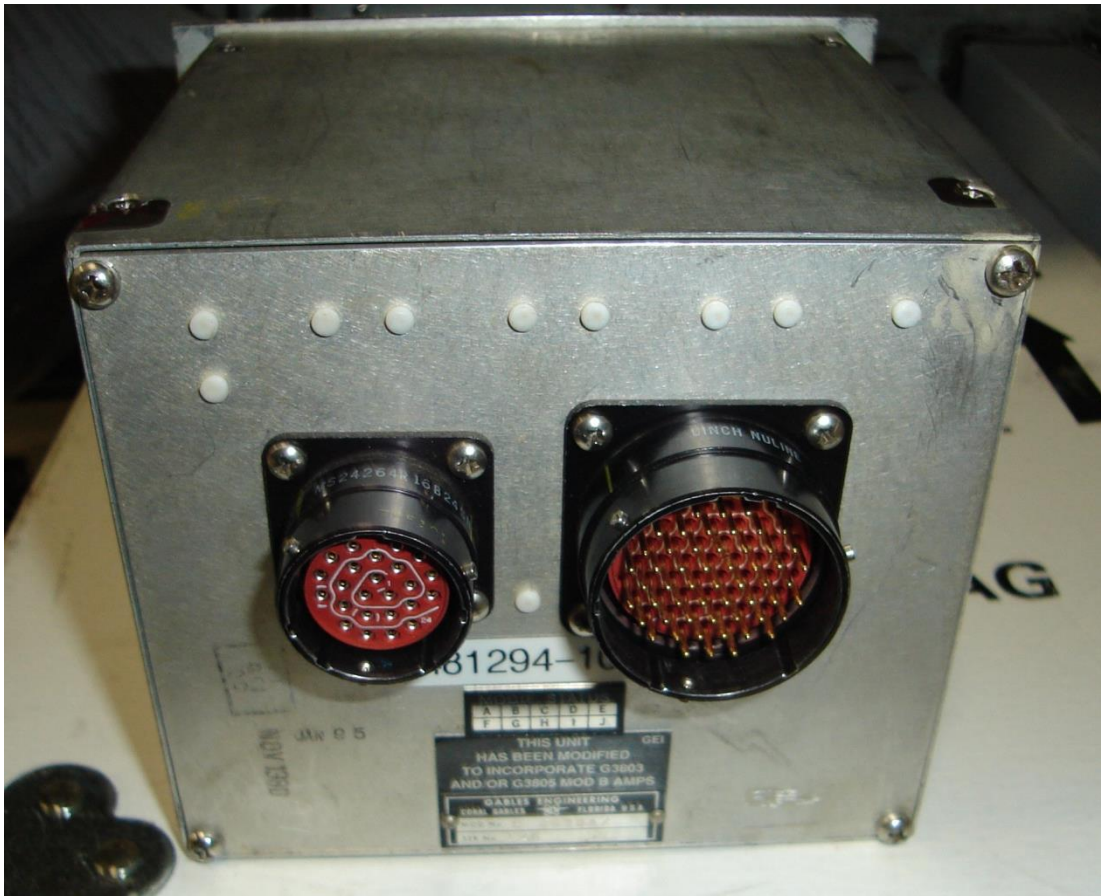


About LRU's:

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***



About Components:

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

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

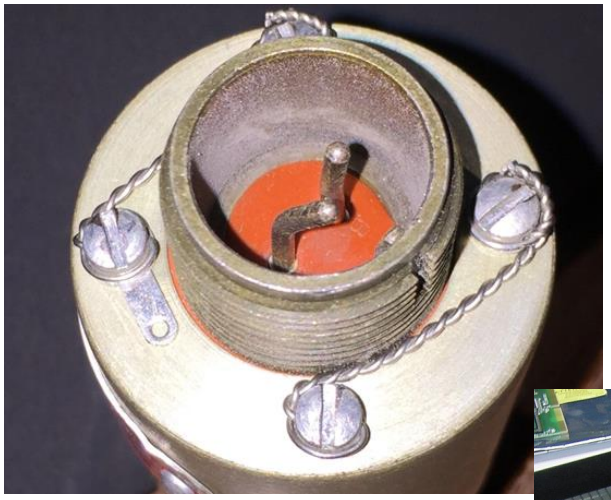
In this case, you MUST be properly protected

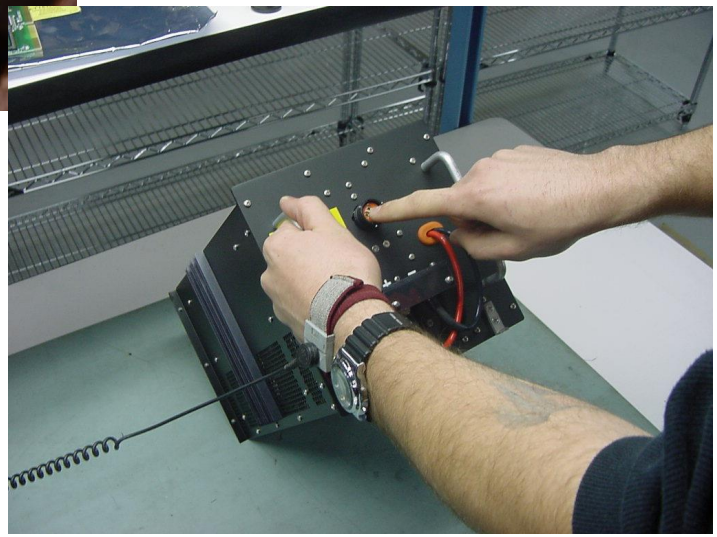
About Components:

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

About Components:

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





About Working the Aircraft:

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

Training

“Training

Persons who handle ESD sensitive parts should have the following topics documented in their training files:

A.What is ESD?

B.Sources of static charges

C.Use and care of the EPA

D.Packaging”

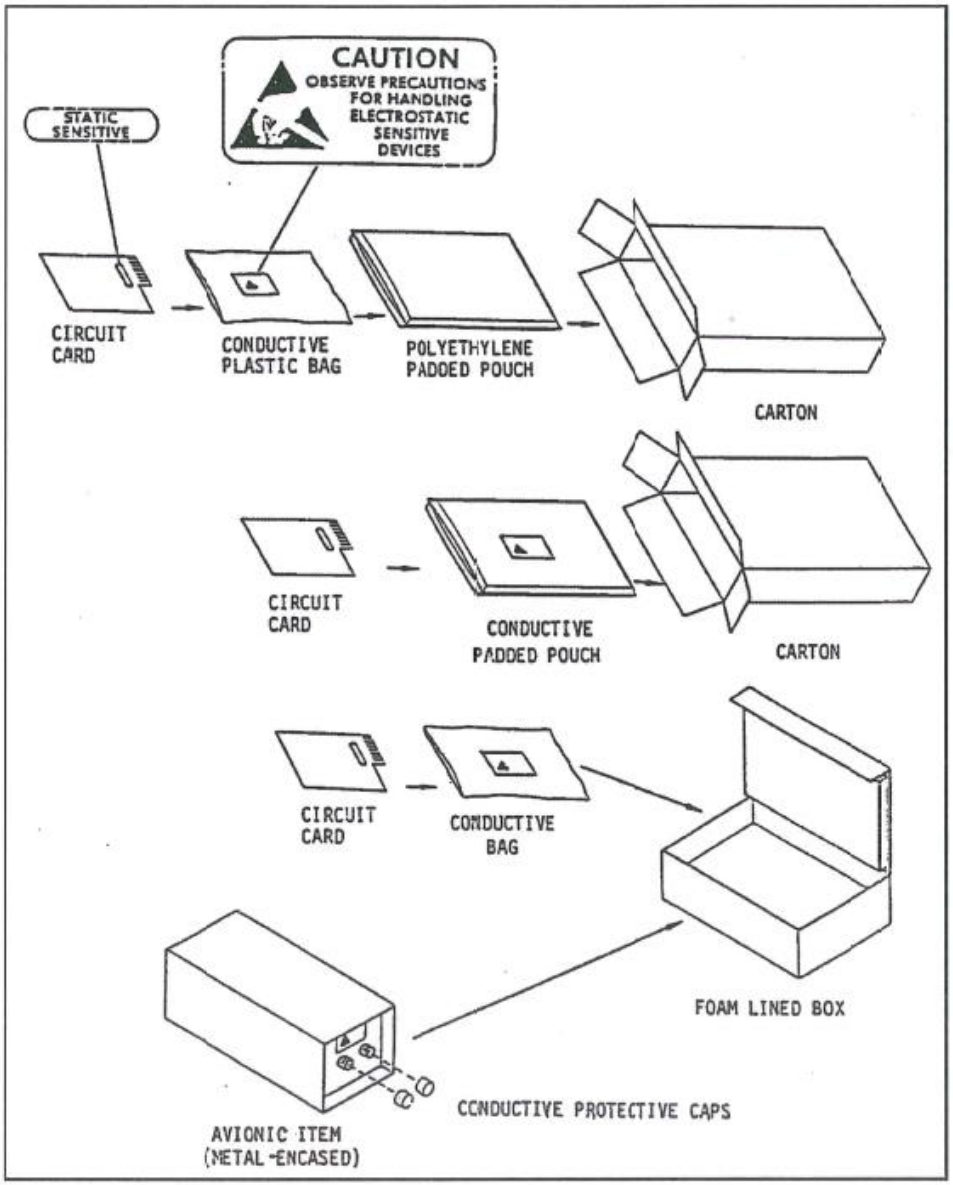

Next:
Packaging

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 or appliances). ATA Specification 300 offers simple additional guidance."

ESD Packaging: A common standard is ATA Specification 300

Figure .1. Packaging of Electrostatic Discharge Sensitive Devices



PACKING SHEET

Page x of x

Excerpt from ATA SPEC 106

Supplier Information

Master Carton Number	Hazmat	Packing Shee

Sold To:	Ship To:	Forward To:

Miscellaneous

Customer Order Number	Customer Item Number	Shipped Part Number	Part Serial Number	Description	Shipment Quantity	Unit of Measure	Unit Price Amou
	Mfr. Date	Harmonized Tariff Code	ESDS	Ordered Part Number	Shipment	Auth.	Country of Mfr.
	Mfr. Date	Harmonized Tariff Code	ESDS	Ordered Part Number	Shipment	Auth.	Country of Mfr.

A very good practice is to 'declare' the ESD part as much as possible so that others in the handling chain will know to apply the proper care

End of:
Packaging

Next:
Management of Static Charges on the aircraft

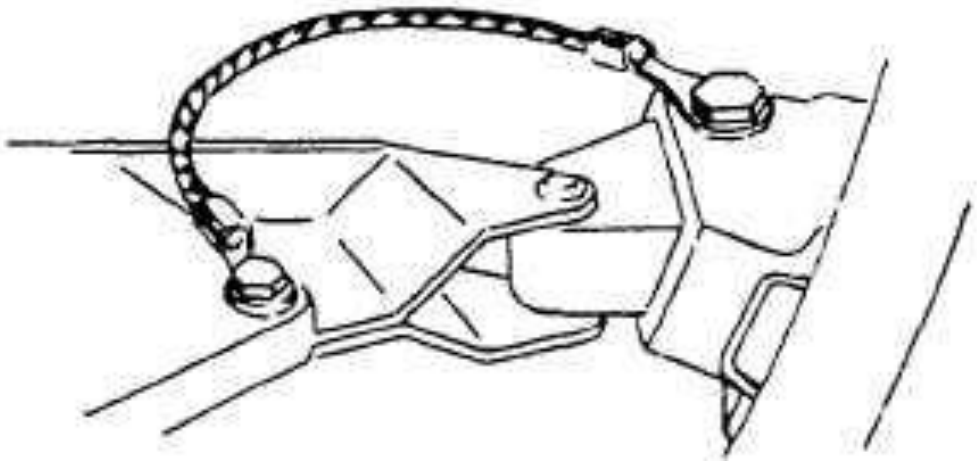
JEOPARDY!

www.jeopardy.com

ANSWER:

This aircraft design feature assures various parts of aircraft structures are strapped together to eliminate static charges from sparking

Bonding straps are placed throughout the aircraft so that there is a continuous electrical connection between parts. This is designed so that there are no gaps which static electricity could jump between, in the form of a spark



JEOPARDY!

www.jeopardy.com

ANSWER:

The purpose of this aircraft design feature is to expel, or return to the atmosphere, static charges that have build up on the aircraft.

During flight, Static Dischargers, also known as Static Wicks, are designed to discharge built-up static, back into the atmosphere.

AVAILABLE FOR YOUR CONSULTING NEEDS:

Roy Resto: royresto@aol.com, 414-467-3063

linkedin.com/in/royresto

Roy Resto is an experienced aviation industry professional having served in management positions with several firms, and is currently Principal 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


You're Good
To Go!