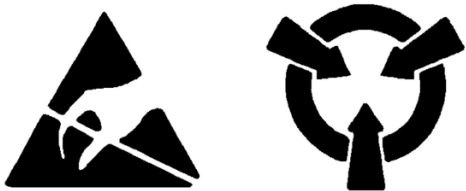


ELECTROSTATIC DISCHARGE COMPONENTS - MAINTENANCE PRACTICES

1. General

- A. The procedures in this section are applicable to all Cessna Operated Service Centers and other facilities that do work with electrostatic discharge (ESD) sensitive devices used on Cessna manufactured or installed components, directly or not directly.
- B. Personnel that do work with electronic components must know the procedures for ESD protection given by this maintenance practice.
- C. It is necessary for personnel that touch ESD sensitive devices to prevent damage to it while they have it, and to make sure that the correct package, label, and ESD data stays with the part.
- D. All personnel that works with ESD sensitive electronic parts must be ESD awareness trained and certified as necessary.
- E. An assembly or equipment that has an ESD sensitive label, which can be threatened by discharge into receptacle pins or terminals, must have a conductive cap, cover or stay in a protected container until the unit is correctly installed into the system.
- F. ESD sensitive devices or assemblies must have placards of some form of one or the two of the symbols that follow printed in black with a yellow background attached where is can be easily seen, to the component or the outer package.

A89816



2. Related Documents

NOTE: The documents that follow are referenced herein. Unless specified differently, the most current revision must be used.

PPC-C-1842	Cushioning Material, Plastic, Open Cell (For Packaging Application)
MIL-STD-1686A	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equivalent
MIL-B-81705	Barrier Materials, Flexible, Electrostatic-Free, Heat Sealable
MIL-P-81997	Pouches, Cushioned, Flexible, Electrostatic-Free Recloseable, Transparent
MIL-P-82646	Plastic Film, Conductive Heat Sealable, Flexible
MIL-B-82647	Bags, Conductive Plastic, Heat Sealable, Flexible
MIL-STD-129	Marking For Shipment And Storage
MIL-STD-701	Lists of Standard Semiconductor Devices
ASTM-D257	D-C Resistance or Conductance of Insulating Materials
EIA Std. RS-471	Symbol and Label for Electrostatic Sensitive Devices
DOD-HDBK-263	Electrostatic Discharge Control Handbook for Protection Of Electrical and Electronic Parts, Assemblies and Equipment

3. Tools and Equipment

NOTE: You can use equivalents tools and equipment.

Name	Number	Manufacturer	Use
------	--------	--------------	-----

Bag Checker	Model 705	3M Static Control Systems P.O. Box 2968 Austin, TX 78769	Bag checker (not necessary if the Model 711 is used).
Charge Analyzer	Model 711	3M Static Control Systems	To do different test procedures for the static control equipment and materials.
Connector Covers	4270	3M Static Control Systems	To prevent damage to the electrical connectors on ESD sensitive components.
Connector Covers	4720	3M Static Control Systems	To prevent damage to the electrical connectors on ESD sensitive components.
Electrically Conductive Plastic Assembly Rack	Model 4018	3M Static Control Systems	To use as ESD work area equipment.
Electrically Conductive Tote Boxes	Type 4415, 4425 and 4428	3M Static Control Systems	To use as ESD work area equipment.
Floor Mat	Model 8200	3M Static Control Systems	To use as ESD work area equipment.
Ionized Air Blower	Model 909	3M Static Control Systems	To use as ESD work area equipment.
Monitor	Model 790	3M Static Control Systems	To examine wrist straps and work surfaces.
Static Shielding Bag	Type 2100 E	3M Static Control Systems	To use as ESD work area equipment.
Table Mat	Model 8210	3M Static Control Systems	To use as ESD work area equipment.
Wrist Strap	Model 8210	3M Static Control Systems	To use as ESD work area equipment.

4. Quality Assurance

- A. A scheduled inspection must be done to make sure that all the necessary technical precautions and instructions of this standard are used by all personnel. Some applicable procedures are as follows:
 - Use of the correct package
 - Certified work stations and equipment
 - Correct ways to touch and send equipment
 - Make sure that all ESD sensitive work is done in a certified area.
- B. DOD-HDBK-263 and MIL-STD-1686A can be used as references for more correct procedures and recommendations to obey this standard.

5. Definitions

- A. A component, assembly or device whose electrical and/or physical function can be changed because it touches an electrostatic discharge or field is to be thought of as electrostatic discharge sensitive. Electrostatic discharge sensitivity is the maximum possible electrostatic discharge (quantity and length of time) to which the component, assembly, or device can have when it is touched and kept and not be damaged.
- B. For the purpose of this maintenance practice a device is considered electrostatic discharge sensitive as follows:
 - (1) A component, assembly, or device whose electrical and/or physical characteristics may be altered by an electrostatic discharge from a 100 pF capacitor charged to 15 kv (15,000 V) or less through a 1.5 Kohm resistor, through the part, assembly or device to ground.
 - (2) These conditions typically model the maximum possible electrostatic discharge which may be encountered in an

uncontrolled handling and storage environment.

C. Electrostatic Discharge (ESD)

- (1) A movement of an electrostatic charge between objects at different electrostatic potentials caused by a direct contact or caused by an electrostatic field.

D. ESD Sensitive

- (1) Electrostatic Discharge Sensitive.

E. Electrical and Electronic Part

- (1) A part such as a microcircuit, discrete semiconductor, resistor, capacitor, thick or thin film device, or piezoelectric crystal.

F. ESD Protected Material

- (1) Material that can do one or more of the items that follow:
 - (a) Control the generation of static electricity and quickly dissipate electrostatic charges over its surface or volume. It can also supply protection from ESD spark discharge or electrostatic fields.
 - (b) ESD protected materials are divided into categories in accordance with their surface resistance (or alternative conductivity) as conductive, static dissipative, or antistatic.

G. Conductive Material

- (1) ESD protected material that has a surface resistance of 10⁵ ohms/square maximum.

H. Static Dissipative Materials

- (1) ESD protected materials that have a surface resistance that is between 10⁵ and 10⁹ ohms/square.

I. Antistatic Material

- (1) ESD protected material that has a surface resistance between 10⁹ and 10¹⁴ ohms/square.

J. Insulative Material

- (1) Material that has a surface resistance that is more than 10¹⁴ ohms/square.

K. Protected Area

- (1) An area which is assembled and has the necessary ESD protection materials and equipment to control ESD voltage below the sensitivity level of ESD sensitive items that are touched.

L. Hard Ground

- (1) A connection to ground directly or through a low impedance.

M. Electrostatic Detection Units

- (1) Types of electrostatic detection units include electrometer amplifiers, electrostatic voltmeters, electrostatic field meters, and leaf deflection electroscopes. The detection units can include electrostatic field meters which are battery operated and portable. Field meters supply indications of the electrostatic fields made by charged bodies and use a non-contact probe or sensor, and supply indications in electrostatic field strength or electrostatic voltage at a calibrated distance from a charged body. Some electrostatic field meters use radioactive sources that are almost the same to those of radioactive ionizers.

N. Ionizers

- (1) Ionizers dissipate electrostatic charges by ionizing air molecules that make both positive and negative ions. The positive ions are pulled to bodies with a negative charge and negative ions to bodies with a positive charge. This causes the charge to become neutral. Use ionized air when you cannot get a good ground to bleed-off static charges, or to dissipate charges on insulators where a ground would not be effective.

O. Topical Anti Stats

CAUTION: Do not apply topical anti stats to electrical circuit boards, parts, or assemblies since they can increase conductivity or possibly have an effect on solderability.

- (1) Topical anti stats are chemical agents which will decrease an insulative materials ability to make static when it is applied to the materials surface.
- (2) Topical anti stats are usually liquids that have a carrier and an anti stat. The carrier moves the anti stat to a material. It acts as a solvent and can be water, alcohol, mineral spirits or other compatible materials.
- (3) The anti stat is the material which stays on the material surface after the carrier dries and supplies the static control

function.

- (4) Topical anti statics can be put on with a brush, spray, roller, or mop and applied to floors, carpets, work bench tops, parts trays, parts carriers, chairs, walls, ceilings, tools, paper, plastics, and clothing to give them different quantities of ESD protection.
- (5) Some topical anti statics are good cleaners and can be mixed with water to clean surfaces such as floors and bench tops and at the same time make them antistatic.
- (6) It is possible that topical anti statics can be removed when you clean with solvents. It can be necessary to apply the treatment to the cleaned work and tool surfaces again.
- (7) The rate that the topical anti static is applied and the quantity that it is touched can supply protection for more time. This must be examined at intervals to find out if it was applied correctly. Use the applicable test equipment and measure the surface resistance of a sample.

P. ESD Container

- (1) A receptacle with a rigid bottom and sides that is used for ESD and protection.

Q. ESD Protected Packages

- (1) Packages with ESD protected materials to prevent ESD damage to ESD sensitive items.

R. ESD Sensitive Items

- (1) Electrical and electronic parts, assemblies, and equipment that are sensitive to ESD voltages of 15,000 volts or less as given by the item's manufacturer.

6. Examples of Known Sensitive Devices

A. Metal oxide semiconductor (MOS) devices that include C, D, N, P, V and other MOS technology without protected circuitry, or protected circuitry that has Class 1 sensitivity:

- Surface acoustic wave (SAW) devices
- Operational amplifiers (OP AMP) with MOS capacitors that do not have protection
- Junction field effect transistors (JFET) (Equivalent to MIL-STD-701 - JFET's and JFET's, dual-utilized)
- Silicon controlled rectifiers (SCRs) with $I_o < 0.175$ amp at 100°C ambient temperature (Equivalent to MIL-STD-701 - Thyristors [silicon controlled rectifiers])
- Precision voltage regulator microcircuits (Line or load voltage regulation $< 0.5\%$)
- Microwave and UHF semiconductors and microcircuits (ZFrequency > 1 GHz)
- Thin film resistors (Type RN) with a tolerance of 0.1%; power > 0.05 watt
- Thin film resistors (Type RN) with a tolerance of $> 0.1\%$; power 0.05 watt
- Large scale integrated (LSI) microcircuits that include microprocessors and memories without protected circuitry, or protected circuitry that has sensitivity devices (LSI devices usually have two to three layers of circuitry with metallization crossovers and small geometry active elements)
- Hybrids that use ESD sensitive parts.

B. MOS devices or devices that contain MOS devices that include C, D, N, P, V or other MOS technology with protected circuitry that have sensitivity devices:

- Schottky diodes (Equivalent to MIL-STD-701 - silicon switching diodes [shown in sequence of a t_{rr} increase])
- Precision resistor networks (Type RZ)
- High-speed emitter couple logic (ECL) microcircuits with a delay increase of one nanosecond
- Transistor-transistor logic (TTL) microcircuits (Schottky, low power, high-speed, and standard)
- OP AMP's with MOS capacitors with protected circuitry that have sensitivity parts
- LSI with input protection that use ESD sensitivity.

C. Lower Power Chopper Resistors (Equivalent to MIL-STD-701):

- Power chopper transistors
- Resistor chips
- Small signal diodes with power one watt, zener diodes not included (Equivalent to MIL-STD-701 - Silicon switching diodes [shown in sequence of a t_{rr} increase])
- General purpose silicon rectifier diodes and fast recovery diodes (Equivalent to MIL-STD-701 - Silicon axial lead power rectifiers, silicon power diodes [shown in sequence of maximum DC output current] and fast recovery diodes [shown in sequence of t_{rr}])

- Low power silicon transistors with power five watts at 25°C (Equivalent to MIL-STD-701 - Silicon switching diodes [shown in sequence of a trr increase], Thyristors [bi-directional triodes] and silicon PNP low power transistors [Pc five watts at TA -25°C), silicon RF transistors]
- Piezoelectric crystals.

7. Requirements

- A. Component containers that contain ESD sensitive devices as received from vendors must be opened only by soft grounded personnel at ESD protected stations or static safe areas for electrical inspection, packaging or for installation into higher assemblies. When you open the containers and remove the devices, you must follow all of the applicable instructions of this standard.
- B. The detailed instructions that follow are specified to supply control procedures for the protection of ESD sensitive electronic components and assemblies until they are installed in the final assembly product.
NOTE: ESD protection keeps all ESD sensitive components and assemblies that do not operate at the same electrical potential. If the personnel, components facilities and tools are all at the same potential, no extraneous charge can be transmitted to the ESD sensitive device(s).
- C. ESD sensitive devices and assemblies with no protection must only be touched by correctly grounded personnel at ESD protected stations or areas that are equal to or more than the standards that follow.
- D. Environmental Conditions
 - (1) The work areas that touch, assemble and do room ambient tests of ESD sensitive devices and assemblies must be air conditioned and kept at 75°F, +10 or -10°F (23.89°C, +5.56 or -5.56°C) and the relative humidity must not be less than 40%.
 - (2) When the humidity levels decrease below 40%, air ionizer equipment must add to ESD protected stations and/or portable humidifiers must be operated to put humidity levels up to minimum limits so that work can continue.
 - (3) Use precautions to make sure that bad quantities of room ambient air that contain moisture will not cause dangerous effects on units that are being worked on.
 - (4) Humidity controls are not necessary in areas where ESD sensitive equipment are in electrostatic protected packaging, barrier materials, enclosures, or containers.
- E. Test Equipment
 - (1) Test equipment must have all metallic surfaces that show electrically connected to the test equipment power system ground (200 ohms or less) when measured with a Simpson Ohmmeter Model 260, equivalent or better, R \times 10 scale.
- F. Carpet
 - (1) Do not use carpet in ESD protected areas, unless the carpet is certified as static safe.
- G. Storage and Transportation Equipment
 - (1) Trays, carriers, tote boxes, cushioning material, and bags used to send, store, or hold components or assemblies must have a surface resistance that is less than 105 ohms/square when measured in accordance with ASTM Test Method D257 or equivalent or better.
- H. Grounding
 - (1) Protected areas must have all grounds connected to a common point, with that point connected earth ground with wire (a cold water pipe is a satisfactory ground).
- I. Temperature Chambers
 - (1) When temperature chambers are used they must have grounded baffles or alternately ionized air or shields to divert direct air flow over the electronic components and subassemblies in the temperature chamber. Electronic ESD sensitive components that have not been assembled must be put in containers with a surface resistance of 109 ohms/square or less when measured in accordance with ASTM Test Method D257 or equivalent, and is resistant to the test temperatures.
- J. Electrical Equipment, Tools, Soldering Irons, Solder Pots, and Flow Soldering Equipment
 - (1) Soldering irons, solder pots, or flow soldering equipment must be transformer isolated to the power line and also be grounded. The resistance indication from the tip of a hot soldering iron to ground must be less than 20 ohms (Simpson Model 260 ohmmeter or equivalent R \times 1 Scale).
 - (2) It is not necessary to ground low voltage (less than 15 volts) soldering equipment if the isolation transformer has a

grounded electrostatic shield between its primary and secondary windings.

- (3) Other electronic equipment or tools which touch electrical components or assemblies must be grounded (200 ohms or less) when measured with a Simpson Model 260 ohmmeter, equivalent or better, R \diamond 10 scale.
- (4) ESD protected "solder suckers" such as metallized or protected types must be used.
- (5) Do not use hand tools with insulation on the handles unless they have staticide materials applied at intervals. Refer to Topical Anti Stats.

K. Static Safe Work Area

- (1) Touch and do tests of electronic components and assemblies at a static safe work area as shown in the Typical Static Free Work Area and Necessary Equipment illustration. Prevent material that is not conductive from going into the area with ESD sensitive equipment, for example, Styrofoam cups, tapes that are not conductive, plastic spooled solder, polyethylene materials).

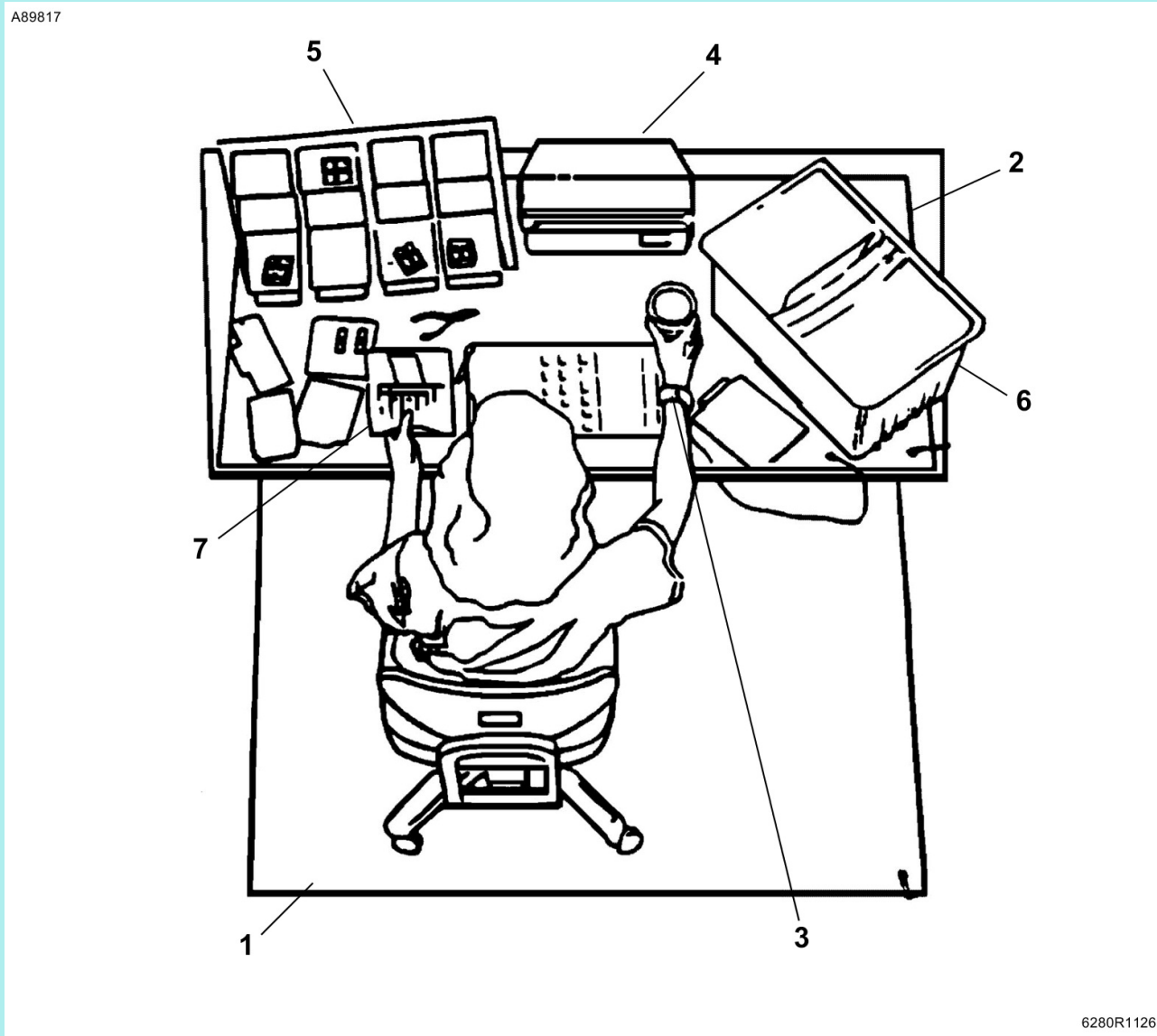


Table 201. Satatic Free Work Station Items

Item Number	Description		
1	Floor Mat		
2	Table Mat		
3	Wrist Strap		

4	Ionized Air Blower		
5	Electrically Conductive Plastic Assembly Rack		
6	Electrically Conductive Tote Boxes		
7	Static Shield		

- (2) The purpose of the static safe work area is to supply a route for static charge which could damage sensitive components. Such work areas have a conductive or antistatic work surface which is connected to a common ground and the person's skin, a wrist strap is recommended, with a minimum 500 kilohms resistance to prevent shock if the person touches live circuitry. An ionized air blower can be necessary for more sensitive work.

Table 202. Static Free Workstation Resistance Values

Indication from Personnel Through	Maximum Permitted Resistance (NOTE 1)	Acceptable Discharge Rate
Floor mat to ground	1000 megohms	Less than 1 second
Table mat to ground	1000 megohms	Less than 1 second
Wrist strap to ground	100 megohms	Less than 0.1 second

NOTE 1:

The minimum resistance to ground for each is 500 kilohms.

L. Ionized Air Blowers

- (1) You can use ionized air blowers as environmental control devices to remove static buildup in the work area. You can also use them in or on equipment that use unbaffled high velocity flow of dry air or gasses when ground procedures cannot be used. The ionized air blowers (can remove voltages to 10,000 volts from a distance of three feet (0.91 m) in a period of 15 seconds or less) must be put at a maximum distance of four feet (1.22 m) from the electronic component or assembly.
- (2) Do not only use ionizers as protection from ESD, unless the safety of personnel prevents the use of ground straps or the use of ground straps becomes not possible.

M. Personnel Clothing

- (1) Personnel must not put on or remove shop coats in the area where ESD sensitive devices are not in a package.
- (2) Do not put on smocks, gloves, or finger cots made of plastic, rubber, or nylon.
- (3) When you put on outer protective clothing (smock, etc.) it must have a surface resistance of less than 1014 ohms/square when it is measured in accordance with ASTM Method D257 or equivalent.
- (4) Prevent physical activities that are not necessary in the area of ESD sensitive devices which can cause friction, for example, if you clean wipe your feet or rub your hands.

N. Personnel Grounding

- (1) Personnel that touch ESD sensitive items must put on wrist straps that touch skin and are in accordance with the necessary resistances of Tools and Materials and Static Free Workstation Resistance Values to safely remove personnel static charges to ground and make personnel static levels equal with that of the grounded work area.
- (2) You can use alternative ground procedures with wrist straps that include conductive shoes, shoe or heel ground straps or covers, with ESD protected floors or mats.
- (3) When you are not at a grounded work area, personnel can use alternative ground procedures that include conductive shoes, shoe or heel ground straps or covers, with ESD protected floors or mats. Refer to Ionized Air Blowers when it is not possible for personnel to be grounded.

O. Handling

- (1) Personnel must be at static safe work areas when they put in and remove from packages, do work on, or touch components and assemblies.

P. Printed Circuit Board (PCB) Assembly Handling

- (1) Personnel must be grounded to the airplane before they remove or install PCB's which are clearly identified with the ESD sensitive marking. Use an approved wrist strap to be grounded to the airplane. Assemblies that are removed must be put in ESD protected packages before personnel remove the ground.

Q. Black Box Assembly Handling

- (1) Assemblies and/or black boxes that are clearly identified with the ESD sensitive marking must be touched or moved carefully. ESD connector protected covers must be installed immediately after you disconnect the airplane wire harness from the unit.
- (2) Only connector covers that have the ESD marking are approved.
- (3) Protective covers must be used on assemblies for more protection.

R. Component Handling

- (1) Use the body of the ESD sensitive components and devices to move or touch it if their dimensions let it. Do not move or touch them by their leads.

S. Protective Covers

- (1) If you do not do work on ESD sensitive components and assemblies, they must have a cover put on, be wound, put in a bag or tote tray, barrier materials, or container that is made of the applicable ESD protected materials that are conductive, remove static, or are antistatic. These protected materials must have a maximum surface resistance as specified in Definitions.
- (2) ESD sensitive objects must be put in static shielding bags and/or sealed containers when they are sent or kept in storage to keep foreign material out and keep the applicable protection.
- (3) Put sensitive components and assemblies in antistatic bags, boxes, or wind them with the applicable material when you do not do work on them.
- (4) If Receiving Inspection must count the parts, they must not be removed from the vendor package.

T. Power Applied to Leads

- (1) Do not apply power to the component or assembly test socket(s) during installation or if it is connected.

U. External Leads

- (1) Components and assemblies received, sent, or in storage must be packed so that the external leads are electrically connected to each other through ESD materials that are not more than 105 ohms/square when measured in accordance with ASTM Test Method D257 or equivalent. ESD protected materials that are conductive, remove static, or are antistatic, can be bags, DIP tubes or vials, rigid shorting bars and clips, foam shapes used to make part leads shorter, assembly connectors, or to cushion for packaging.

V. Marking of Containers

- (1) Components and assemblies received, sent, or in storage must have a mark or tape with a legend that has a color that gets attention and is easily read with normal or corrected vision at a distance of three feet on their related container. The legend that follows or an equivalent must be used: CAUTION - ELECTROSTATIC SENSITIVE DEVICE: DO NOT REMOVE THE ANTISTATIC PROTECTION EXCEPT WHEN YOU APPLY A TEST VOLTAGE OR FOR FINAL ASSEMBLY.

W. Packing Material

- (1) Wind components and assemblies in materials with a maximum surface resistance of 109 ohms/square if the packing material has a surface resistance of more than 1014 ohms/square and is used in the packing. Measurements must be in accordance with ASTM Test Method D257 or equivalent or greater. Bubble pack material or open cell plastic foam used for a cushion for packaging such as MIL-P-81997 and PPP-C-1842 Type III, Style A, are recommended materials. Packaging and cushion materials in accordance with MIL-B-81705, conductive plastic films in accordance with MIL-P-82646, and conductive flexible plastic bags in accordance with MIL-P-82647 are permitted packing materials.
- (2) make sure that any warning or precaution marking stays on the packaging as it is received from the vendor.

8. Typical Prime Charge Sources Which Must Be Prevented**A. Work Surfaces**

- Surfaces with wax, paint, or varnish
- Vinyl or plastics.

B. Floors

- Sealed concrete
- Wood with a finish or wax

- Vinyl tile or sheeting.

C. Clothing

- Clean room smocks
- Synthetic personnel clothing
- Shoes that are not conductive
- Virgin cotton.

NOTE: Virgin cotton can be a static source at low relative humidities such as below 30%.

D. Chairs

- Finished wood
- Vinyl
- Fiberglass.

E. Packaging and Handling

- Plastic bags, wraps, or envelopes
- Bubble pack or foam
- Plastic trays
- Plastic tote boxes, vials, or part bins.

F. Assembly, Cleaning, Test and Repair Areas

- Spray cleaners
- Plastic solder suckers
- Soldering irons with tips that are not grounded
- Solvent brushes (synthetic bristles)
- Temperature chambers
- Cryogenic sprays
- Heat guns and blowers
- Sand blasting
- Electrostatic copiers.