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Increased Need for ESD/EOS Training, Audits and Compliance

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Device Susceptibility

Typical figures for susceptibility of devices to ESD damage

Device type	ESD susceptibility
Bipolar transistors	380 to 7000 Volt
CMOS logic devices	250 to 3000 Volt
EPROM devices	100 volt
Film resistors	300 to 3000 Volt
TTL logic devices	1000 to 2500 Volt
Microprocessor chips	as low as 10 Volt

Adapted from http://philipstorr.id.au/pcbook/book5/esd.htm

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The ESD Impact in MFG

Typical Electrostatic Voltages (Volts)			
	Relative Humidity		
Event	10%	40%	55%
Walking across a carpet	35,000	15,000	7,500
Walking across a vinyl floor	12,000	5,000	3,000
Motions of bench employee	6,000	800	400
Removing components (DIP) from plastic tubes	2,000	700	400
Removing DIPs from vinyl trays	11,500	4,000	2,000
Removing DIPs from polystyrene foam	14,500	5,000	3,500
Removing bubble pack for PWBs	26,000	20,000	7,000
Packing PWBs in foam-lined box	21,000	11,000	5,500

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ESD/EOS Definition

- ESD – Electrostatic Discharge
- EOS – Electrical Overstress

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ESD Spec

ANSI/ESD S20.20-1999

ESD association standard

for the Development of an Electrostatic Discharge Control Program for –

Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

ANSI/ESD S20.20-1999

ESD ASSOCIATION

Electrostatic Discharge Association
7900 Turin Road, Bldg 3, Ste 2
Rome, NY 13440-2069

An American National Standard
Approved August 4, 1999

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What Does 20.20 Say?

This standard covers the requirements necessary to design, establish, implement, and maintain an Electrostatic Discharge (ESD) Control Program for activities that:

- Manufacture, process, assemble, install, package, label, service, test, inspect or otherwise handle electrical or electronic parts, assemblies and

- Equipment susceptible to damage by electrostatic discharges greater than or equal to 100 volts Human Body Model (HBM).

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20.20 States

- We have to be careful when handling devices susceptible to less than 100 volts HBM, as more stringent ESD Control Program Technical Requirements may be required, including adjustment of program Technical Element Recommended Ranges.

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20.20 States

This document covers the control program requirements and offers guidance to protect and handle ESD sensitive (ESDS) items, based on the historical experience of both military and commercial organizations.

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Overview – Administrative Requirements

- Each facility shall have a control plan which describes the scope of the program
  - Includes a training plan
  - Establishes a compliance verification plan

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Overview – Technical Requirements

- Grounding and Bonding Systems
- Personnel grounding
- Protected areas
- Packaging
- Marking
- Handling

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Table 1- ESD Control Program Technical Requirements Summary

(See paragraph 6.2 for further guidance regarding alternate test methods.)

Technical Requirement	Reference Paragraph	Implementing Process or Method	Area 1 Mfg.	Area 2 Field	Test Method, *Standard or Advisory*	Recommended Range[5]
Grounding / Bonding Systems	6.2.1				ANSI EOS/ ESD S 6.1	
		Equipment Ground	R	O	ANSI EOS/ ESD S 6.1	< 1.0 ohm AC Impedance
		Auxiliary Ground	O	O	ANSI EOS/ ESD S 6.1	< 1.0 ohm AC Impedance
		Equipotential Bonding	O	O	ESD ADV 2.0	< 1.0×10^9 ohm[6]
		Common Point Ground	R	O	ANSI EOS/ ESD S 6.1	< 1.0 ohm AC Impedance
Personnel Ground	6.2.2					
		Wrist Strap System			ESD S 1.1	< 35×10^6 ohm[7]
		Seated Operations	R	R		
		Standing Operations	O	O		
		Flooring – Footwear System	O	O	ESD STM 97.1 or ESD STM 97.2	< 35×10^6 ohm[6] or < 100 Volts[6]
Protected Area	6.2.3					
		Work Surface	O	O	ESD S 4.1	< 1×10^9 ohm
					ESD STM4.2	< 200 Volts[6]
		Wrist Strap Cord	O	O	ESD S 1.1	0.8×10^6 to 1.2×10^6 ohm
		Footwear	O	O	ESD S 9.1	< 1×10^9 ohm[7]
		Flooring	O	O	ANSI ESD S 7.1	< 1×10^9 ohm[7]
		Seating	O	O	ESD STM 12.1	< 1×10^9 ohm[7]
		Ionization (other than room systems)	O	O	ANSI EOS/ESD S 3.1	< ±50 Volts Voltage Offset[6]
		Ionization (room systems)	O	O	ANSI EOS/ESD S 3.1	< ±150 Volts Voltage Offset[5]
		Shelving	O	O	ESD ADV 53.1	< 1×10^9 ohm[7]
		Mobile Equipment	O	O		< 1×10^9 ohm[6]
		Continuous Monitors	O	O	Manufacturer Specification	N/A

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Technical Requirement	Reference Paragraph	Implementing Process or Method	Area 1 Mfg.	Area 2 Field	Test Method, Standard or Advisory	Recommended Range[5]
		Signs	R	O	N/A	
	6.2.4	ESDS Item Packaging	R	R	See ESD Packaging Technical Requirement	N/A
	6.2.6	Equipment			ESD ADV 2.0	
	6.2.6.1	AC Powered Tools	O	O	ESD DS 13.1	< 1.0 ohm[6]
	6.2.6.2	Battery Powered and Pneumatic Hand Tools	O	O		< 1 X 10^{12} ohms[6]
	6.2.6.3	Automated Handlers	O	O	ESD DSP 10.1	
		Garment	O	O	ESD STM 2.1	1 X 10^{5} to 1x10^{11} ohms
		Protective Material Marking	O	O	ESD S8.1	
		Humidity	O	O	N/A	> 30% Rh < 70%[6]
ESD Packaging	6.2.4					
		Conductive	O	O	EOS/ESD S11.11	< 1 X 10^{4} ohms
		Dissipative	O	O	EOS/ESD S11.11 ESD DS11.12	≥ 1 X 10^{4} to < 1 X 10^{11} ohms
		Shielding	O	O	ESD S11.31	< 50 nJ[6]
		Low Charging	O	O	ESD ADV 11.2	
		Protective Material Marking	O	O	EOS/ESD S8.1	

R-Required implementing process or method
O- Optional implementing process or method

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Reference Material

- MIL-HDBK-263
  - This document in Appendix K has the ESD damage Prevention checklist which can be used to audit the area in question

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IPC Training Center

ESD ACCEPTABILITY AUDIT CHECKLIST

Auditor	**Date**	
Company	**Contact**	
Address		
City	**State**	**Zip**
Phone	**Fax**	

1. MANAGEMENT	YES	NO
Is there a documented ESD policy? Policy Number_____		
Are formal audits provided for in the policy?		
Does policy assign responsibility for implementation as part of TQM?		
Is there a statement in the purchase orders to ensure that suppliers of ESDS parts will provide adequate packaging protection and proper marking and labeling in accordance with the requirements?		
If a supplier fails to provide such packaging marking and labeling are the products rejected?		
Is everything that is received in ESD protective packaging materials treated as ESDS?		
Are ESD protective bags, tote boxes and trays provided for use in moving material within the plant?		
Is there a sample for review?		
Are ESD protective workstations in use?		

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Examples of Static Electricity

- Lightning
- The Zap felt when touching a door knob
- Static sensitive hair and clothing

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Definitions

- Conductors are materials that transfer electrons easily
- Insulators are materials that do not transfer electrons easily
- Both can become charged with static electricity.

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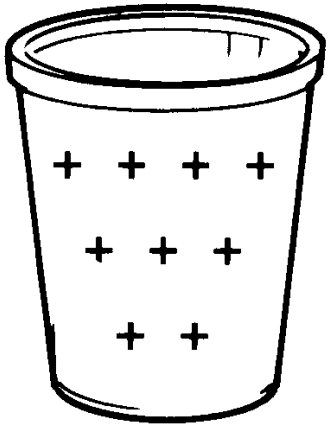
Insulators

- Insulators like this plastic cup will hold the charge.



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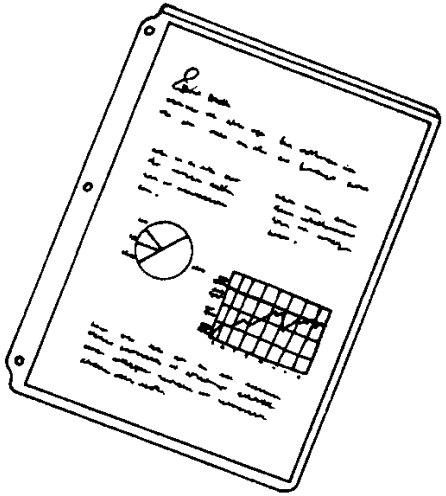
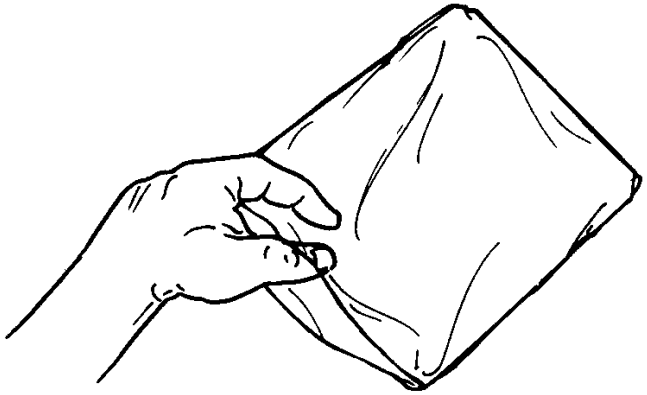
Typical Electrostatic Voltages



Vinyl envelop for work instructions 600 to 7,000 Volts



Picking up a plastic bag from a bench 1,200 to 20,000 Volts

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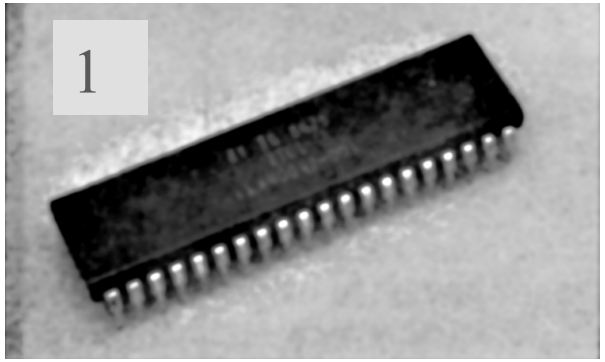
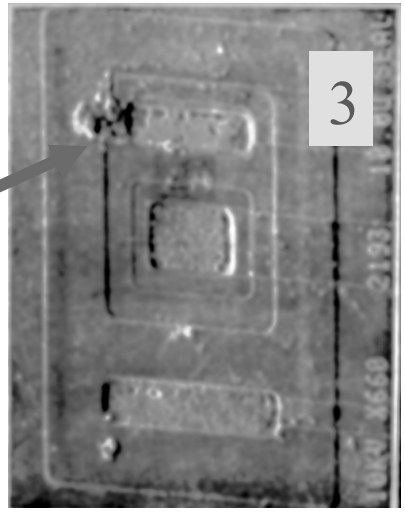
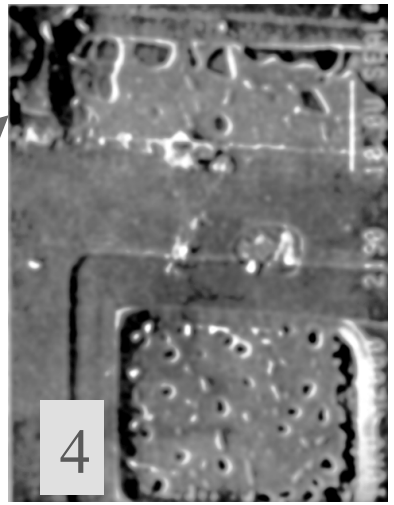
IC Damage Illustration







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Cost of ESD Damage

- Reduce company's profitability
- Affect profit sharing
- Company's ability to compete in the market place

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Basics of ESD Control

- Grounding
- Isolation
- Neutralization
- Prevention
- The most Critical is YOU

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Prevention

- Know when you are working with possible ESD sensitive devices
- When working with ESD sensitive devices make sure you

Ground

Isolate

Neutralize

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Thank You

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Further Information

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