

# ESD Around High Voltage

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We would not recommend grounding personnel when working with voltages over 250 VAC or 500 VDC, as described in the Cenelec Electronic Components Committee standard section 4.1.1, CECC 00015/1. Both our foot grounders and wrist straps employ a 1/4 Watt carbon composite resistor rated 250 Volts Alternating Current (VAC) and UL tested and listed for voltages under 250 VAC.

*UL Marking for Wrist Straps and Foot Grounders:*

## **CAUTIONARY MARKING**

**This product is not recommended for use on equipment with operating voltage exceeding 250 volts.**

There is always a safety concern when working around high voltage. All electrical wiring and ground connections should adhere to the National Electrical Code (NEC) as governed by OSHA. If an operator came in contact with an exposed voltage of 250 VAC and wearing a ground strap or other grounding mechanism with a 1 megohm resistor in line (soft ground), then the current received through the operator to ground would be limited to 250  $\mu$  A, well below the electrical perception level of table VIII in DOD-HDBK-263, refer to Appendix A. In order for an operator to have similar protection when working around high voltages of 20 kVAC, the serial resistance in their ground path would need to be at least 80 megohms.

## **Appendix A**

**Listing of Relevant Documentation for ESD control and high voltages:**

### **ESD Association ADV-2.0-1994**

Safety rules for working with high voltages should dictate the design of the workstation.

### **ESD Association ESD-S1.1 (Standard on Wrist Straps):**

ESD-S1.1, Section 7.1, Construction Guidelines

#### **Current-Limiting Resistance**

A resistance of sufficient resistance to limit current to less than 0.0005 amps (0.5 mA), at the highest voltage that may be encountered, should be incorporated into the wrist strap. Nominally, 800,000 ohms (800 Kilohms) are sufficient for voltages of up to 2401 VAC. The value of 1 Megohms is specified because it is a standard value discrete resistor. Special situations may dictate the use of values above or below the 1 Megohm value. Wrist straps with nominal resistances other than 1 Megohm should be marked in accordance with paragraph 5.9. Discrete current-limiting resistors should be located near the connection between the ground cord and the cuff.

### **ESD Association, ANSI/ESD-S20.20**

In the one of the most comprehensive ESD standards from the ESD Association ANSI/ESD-S20.20, states in section 5. PERSONNEL SAFETY:

The Procedures and equipment described in this document may expose personnel to hazardous electrical conditions. Users of this document are responsible for selecting equipment that complies with applicable laws, regulatory codes and both external and internal policy. Users are cautioned that this document cannot replace or supersede any requirements for personnel safety. Ground fault circuit interrupters (GFCI) and other safety protection should be considered wherever personnel might come into contact with electrical sources. Electrical hazard reduction practices should be exercised and proper grounding instructions for equipment must be followed.

## **According to the ESD S1.1-1998:**

### **7.1 Construction Guidelines Current-Limiting Resistance**

A resistance of sufficient resistance to limit current to less than 0.0005 amps (0.5mA), at the highest voltage that may be encountered, should be incorporated into the wrist strap.

Nominally, 800,000 ohms (800 Kiloohms) are sufficient for voltages of up to 240VAC. The value of 1 Megohms is specified because it is a standard value discrete resistor. Special situations may dictate the use of values above or below the 1 megohm value. Wrist straps with nominal resistances other than 1 megohm should be marked in accordance with paragraph 5.9. Discrete current-limiting resistors should be located near the connection between the ground cord and the cuff.

## According to the ADV-2.0:

### Current Limiting

Most wrist straps have a current limiting resistor molded into the ground cord head on the end that connects to the cuff. The resistor most commonly used is a one megohm, 1/4 watt with a working voltage rating of 250 volts. Resistors limit current as defined by Ohm's Law, which states the current is equal to the voltage divided by the resistance.

In a practical application, the maximum amount of current through a wrist strap ground cord if it was placed across a 250 Volt source is 250 microamps or 0.25 milliamps. This amount of current is well below the 0.7 milliamps that Underwriters Laboratories uses as the peak current in a LIMITED CURRENT CIRCUIT. See document UL 1950.

## ANSI/ESD S20.20 -1999 states:

### 5. PERSONNEL SAFETY

The Procedures and equipment described in this document may expose personnel to hazardous electrical conditions. Users of this document are responsible for selecting equipment that complies with applicable laws, regulatory codes and both external and internal policy. Users are cautioned that this document cannot replace or supersede any requirements for personnel safety. Ground fault circuit interrupters (GFCI) and other safety protection should be considered wherever personnel might come into contact with electrical sources. Electrical hazard reduction practices should be exercised and proper grounding instructions for equipment must be followed.”

ESD Ground cords serve one purpose, to connect a conducting surface to the same potential as ground. There is always a safety concern when working around high voltage. All electrical wiring and ground connections should adhere to the National Electrical Code (NEC) as governed by OSHA. Per ESD Association ADV-2.0-1994, Safety rules for working with high voltages should dictate the design of the workstation.

Desco Wrist Straps [and Foot Grounders] are Underwriter Laboratories listed. UL cautions that these products are not recommended for use on equipment with operating voltage exceeding 250 volts recommending that the electrical current that the operator be exposed to be limited to 0.25 milliamp. At 250 volts, the 1 megohm [1,000,000 ohms] resistor does this.

Desco Wrist Straps [and Foot Grounders] employ a 1 megohm ¼ Watt carbon composite resistor rated 250 Volts Alternating Current (VAC) and UL tested and listed for voltages under 250 VAC. If the Wrist Strap came in contact with an exposed voltage of 250 VAC, and the operator was wearing a Wrist Strap with a 1 megohm resistor, the current received through the operator to ground would be limited to 250 microamps. This is below the human electrical perception level.

When working with voltages over 250 VAC, ESD personnel grounding should not be used, rather ionization may be required to neutralize electrostatic charges.

### MIL-STD-454

All personnel ground straps should have sufficient resistance to ground to limit current to the perception level as shown in MIL-STD-454, Requirement 1.

### DOD-HDBK-263

Section 7.3.1.3, Table VIII, (Ref.: MIL-STD-454)

Effects Of Electrical Current On Humans		
Current Values (mA)		
AC	DC	Effects
60 Hz		

0-1	0-4	Perception
1-4	4-15	Surprise
4-21	15-80	Reflex action
21-100	80-160	Muscular inhibition
40-100	160-300	Respiratory block
Over 100	Over 300	Usually fatal

**CECC 00 015**

**Section 1.1.** For areas with exposed conductors at potentials greater than 1.25 kVAC or 2.5 kVDC, additional requirements specified in CECC 00 015: Part 4 shall apply.

**Section 4.1.1,** The EPA shall be constructed to ensure that the equipment used to control static electricity does not create any additional risk of electric shock to personnel, should energized conductors up to the level of 250 VAC (500 VDC) be exposed.

**Section 4.1.2,** Additional protection against exposed high voltages: In ESD Protected Areas (EPA) where exposed energized conductors exist for each 250 VAC (500 VDC) potential the minimum resistance of any working point to ground shall be  $7.5 \times 10^5$  Ohms. Maximum resistance values in excess of those specified in Section 4 clauses shall not be used.

Although this standard does not include requirements for personal safety, attention is drawn to the need for all concerned to comply with relevant local statutory requirements regarding the health and safety of all persons in all places of work including those covered by this standard. (Attention is drawn to the fact that electrical potentials in excess of 50 VAC or 120 VDC may be dangerous to personnel.)