ELECTRO-SAFE™ from Wilson Industries, Inc.

Wilson Industries, Inc. has developed Electro-Safe ™, a new, scientifically engineered, transparent, anti-static curtain. The Wilson Electro-Safe™ curtain has been designed to eliminate objectionable features of present anti-static curtains when used in particularly demanding conditions.

An outstanding feature of plastic polymeric film is its high surface and high volume resistivity. Although high resistivity is of value in many applications involving electrical and electronic insulation, it also severely limits the application of polymeric films for non-electrical use. This is because such film may become charged with static electricity and thus have its mechanical and optical properties gradually change. Examples are polymeric film becoming charged with static electricity from ultraviolet radiation such as from sunlight or welding arcs, then attracting or holding dust on its surface. Such dust can decrease the light transmission of transparent curtains, or change the appearance of non-transparent curtains due to the change of gloss and color.

Surface charging can also be accomplished simply by having a brisk current of air flowing across the surface, particularly if the surface is at the same time illuminated with ultraviolet light as from open sunlight or welding arc in the vicinity. Such charged curtains or films attract dust and dirt to their surface and hold it there tenaciously. Even more simply, just unrolling a roll of plastic sheet may charge the surface.

Methods heretofore used to alleviate or reduce this charging condition have involved mixing anti-static agents into the film or placing conductive coating materials onto the surface of the film.

When incorporated in the film in useful quantities, the anti-static agents decrease or destroy the transparency; when introduced in quantities allowing some transparency, the small concentrations of conducting material leads to a reticulation and variation of the conductants as the material ages. Other effects noted in PVC film, for example, are changes in color, tensile strength, elasticity, flexibility, chemical resistance, bacterial and fungal resistance, and other valuable properties of the vinyl resin.

When coated on the surface of the plastic film, the conductive coatings are typically composed of about ½% of inert metallic salt, 2 to 4% inert hygroscopic organic compound as a moisture-holding compound, and 2 to 4% of water. Such coatings remain plastic, but are dependent on a suitable humidity balance with the surrounding atmosphere for proper operation. The most stable surface film has been a thin carbon or metallic surface film, or sometimes a tin oxide film, all thin enough for transparency. Such thin films are not resistant to abrasion or cleaning processes, and are subject to corrosion in hostile atmospheres.

The present film "Electro-Safe"™ consists of a polymeric sheet onto which has been incorporated a grid or lattice of conducting paint. The conductive paint lines are 0.1 mm diameter and are applied at a 10 mm separation giving a 2-dimensional square grid result. The applied lines obscure less than 0.1% of the surface, leaving the remainder perfectly clear and transparent, with unaltered physical properties. The thickness of the conductor in the lines is sufficient to assure that the conductivity will not be decreased by handling or cleaning

methods when in use, and yet the "Electro-Safe™" complies with the stringent requirements of the National Fire Protection Association for "Recommended Safe Practice for Hospital Operating Rooms", in which the requirement is given that "no point on a non-conductive element of the surface be more than one quarter of an inch from a conductive element of the surface."

The result of a human being contacting an object charged with static electricity (or conversely, a charged human being, charged as from walking on a wool or non-conducting floor in a dry winter atmosphere, suddenly contacting a grounded surface) is comparable to the discharge of a 100 picofarad capacitor charged to the same voltage.

Under these conditions, if the voltage is up to 170 volts, Category 1 (highly Electrostatic Discharge Sensitive items – ESDS) will be affected.

Category 1 (highly ESDS). **ESDS devices and components damaged by discharges from the human model charged to voltage levels less than or equal to 170 volts. This category shall include but is not limited to the following devices and components: metal oxide semiconductor (MOS) devices without input protection circuitry on all inputs, microwave semi-conductors, dielectrically isolated semi-conductors with internal capacitor contacts connected to external pins, microcircuits utilizing N+ guard ring construction and Surface Acoustic Wave (SAW) devices.**

For voltages from 171 to 2000 volts, Category 2 ESDS items will be affected.

Category 2 (moderately ESDS). **ESDS devices and components damaged by discharges from the human model charged to voltage levels from 171 volts to 2000 volts. This category shall include, but is not limited to the following devices and components: MOS devices with input protection, all other micro-circuits not listed in Category 1 and 3, junction FET's, hybrids utilizing Category 1 or 2 parts, and precision resistor ladder networks.**

For voltages from 2001 volts to 15000 volts, Category 3 ESDS will be affected.

Category 3 (marginally ESDS). **ESDS devices and components damaged by discharges from the human model charged to voltage levels from 2001 volts to 15,000 volts. This category shall include, but is not limited to, the following devices and components:**
Small signal discrete semi-conductor devices not listed in Categories 1 and 2 (less than 10 watts dissipation at 25˚C), thick and thin film resistors, other thick and thin film devices (e.g. substrates) not included in Categories 1 and 2, crystals, standard TTL logic and standard DTL logic.

Over 15,000 volts the human subject will experience sharp discomfort and perhaps reflex action which is potentially dangerous in a work surrounding. The maximum voltage which can be sustained is 30,000-35,000 volts, the limit being set by onset of corona discharge from irregularities. Much of the potential danger is eliminated by assuring a relative humidity from 65-90%.

Typical Measured Electrostatic Voltages

Means of Static Generation	Relative Humidity	
	Low - 10 to 20%	High – 65 to 90%
Walking across carpet	35,000	1,500
Walking over vinyl floor	12,000	250
Worker at bench	6,000	100
Vinyl envelopes for work instructions	7,000	600
Common poly bag picked up from bench	20,000	1,200
Work chair padded with urethane foam	18,000	1,500

Measurements made on "Electro-Safe™" films are given below.

I. Anti-electrostatic efficiency.

Films	Electrified Voltage 22˚C = 71.6˚F (49% RH)
Electro-Safe™ Film	- 200 volts
Anti-electrostatic mixed (flexible) PVC film	-1300 volts
General (flexible) PVC film	-22000 volts

Charging method: Film is rubbed repeatedly with nylon cloth.

II. <u>Electrostatic leakage efficiency.</u>

The Electro-Safe™ film is charged at 20˚C = 68˚F at 73% relative humidity using a static machine generator.

Of 20 measured points on the surface of the film, 18 decreased to half potential in under 5 seconds, 2 decreased to half potential in under 10 seconds. The average time was 6.6 seconds to decrease to half potential.

III. <u>Dust prevention efficiency</u>.

Films	Attracting Distance 22°C – 71.6°F (49% RH)
Electro-Safe™ film	1 cm = 0.4 inches
Anti-Electrostatic mixed (flexible) PVC film	10 cm = 4 inches
General (flexible) PVC film	18 cm = 7 inches

Measurement method: The film is rubbed briskly with a dry nylon cloth, and the distance at which the film begins to attract cigarette ashes is measured.

IV. <u>Electrostatic Impulse Shielding.</u>

The electrostatic field at the surface of a TV tube is measured when the TV is suddenly turned off, with Electro-Safe™ film, normal anti-static film, and untreated PVC film interposed.

Films	Electrostatic Voltage
Electro-Safe™ film	0.4 KV
Anti-Electrostatic mixed (flexible) PVC film	20 KV
No film (blank)	20 KV