CARLISLE FLUID TECHNOLOGIES

FINISHING EDUCATION UNIVERSITY

Coating Non-Conductors Electrostatically

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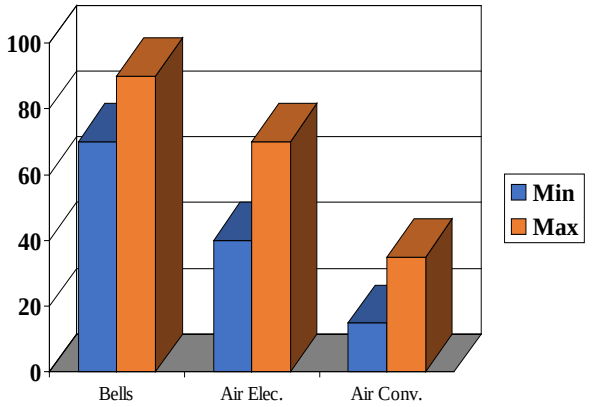
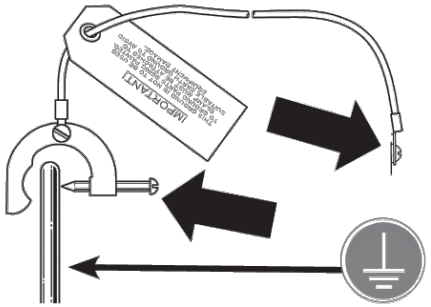
Coating Non-Conductors Electrostatically

Overview:

- History of Electrostatics
- Benefits of Electrostatics
- Techniques for Coating Non-conductors
- Grounding
- Application Examples
- Questions





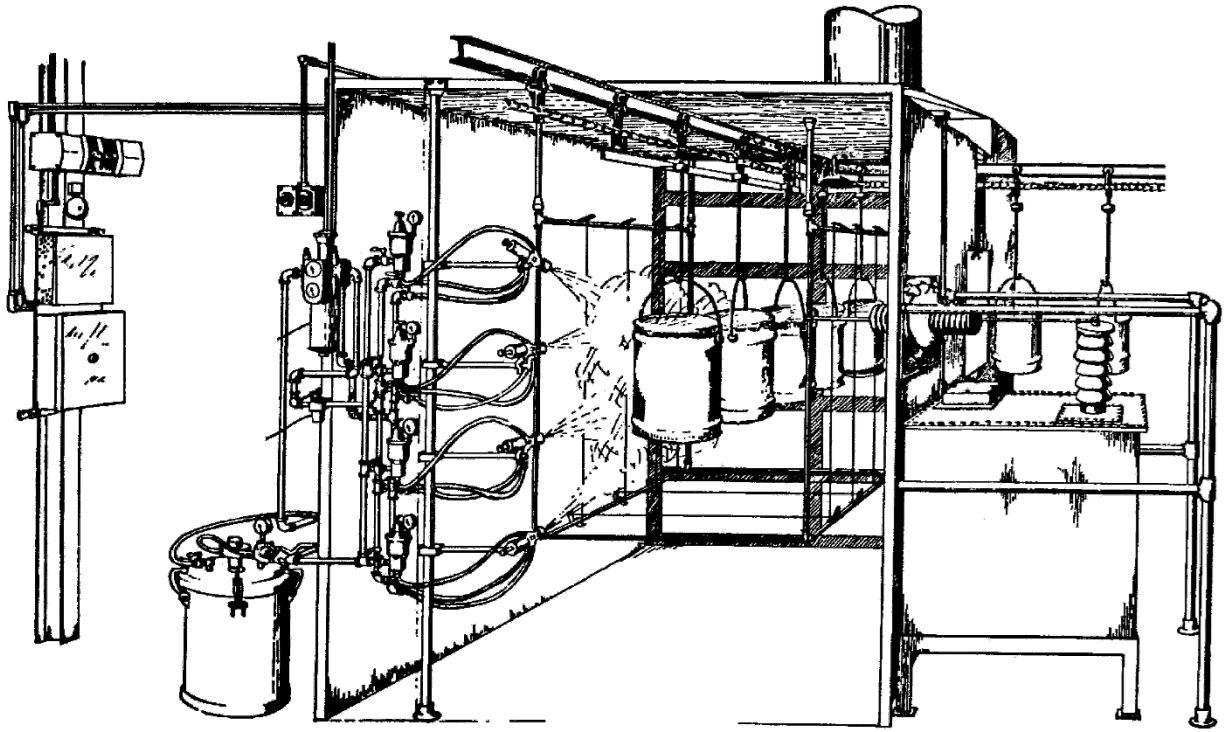
History of – Electrostatic Painting

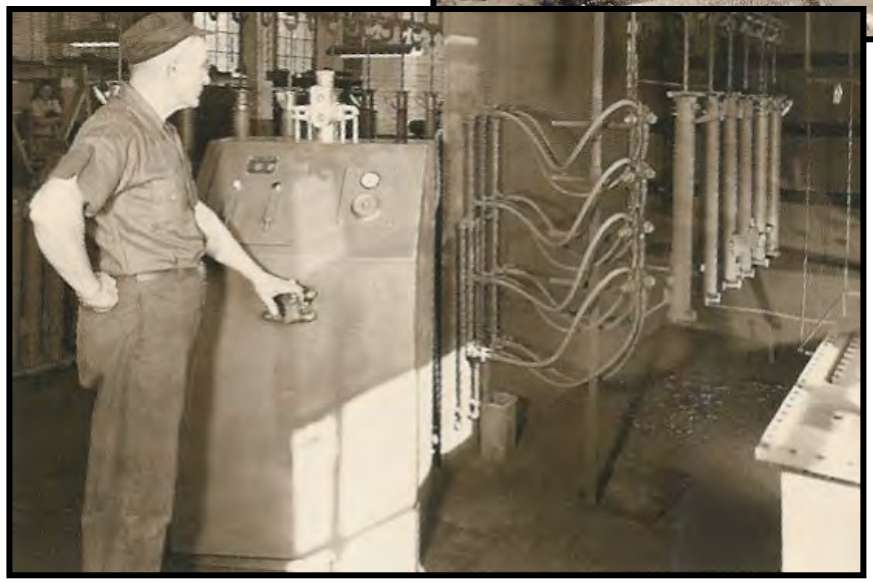
The electrostatics Process was developed by Harold Ransburg in the 1940's.

History of – Electrostatic Painting

#1 Process: Indirect charge

- Product and coating material are at ground potential
- Applicators sprayed through electrostatically charged “grid”
- Atomized coating particles accept “indirect charge”.





History of – Electrostatic Painting

#2 Process: Direct charge – most commonly used today

- Product is at ground potential.
- Coating material is directly charged at the point of atomization.
- Material supply is grounded or at voltage potential.

Electrode in fluid stream transfers charge to fluid.

Metal cup transfers charge to fluid as it is atomized.

History of – Electrostatic Painting

#1 Process: Indirect charge, still used today

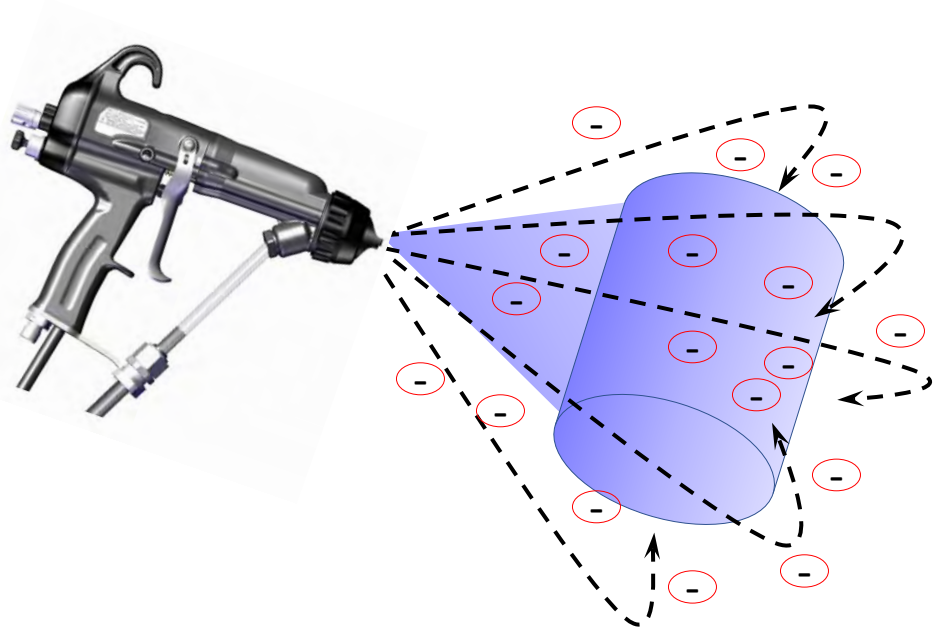
- For application of water-based coatings from grounded fluid supply system.

RMA-670
Rotary Atomizer

RansFlex RFXi
Manual Applicator

Electrostatic Painting: Definitions

- **Electrostatic Painting**: Method of paint application in which a high voltage charge is used to dramatically increase transfer efficiency.
- **Transfer Efficiency**: the ratio of coating solids adhering to an object to the total used in the application process (expressed as a percentage).

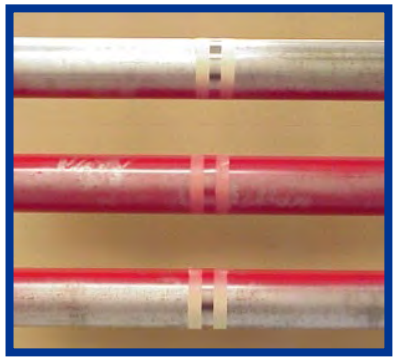


- Coating is negatively charged as it is atomized
- Product coated is at ground potential, and appears to be opposite charge
- Opposites attract: coating is drawn to grounded product.

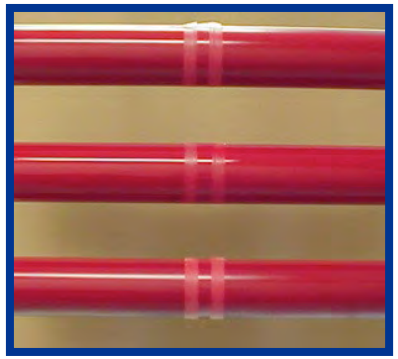
Electrostatic Painting: Benefits

- More forgiving application
- Electrostatic “wrap”
- Better uniformity
- Increased transfer efficiency
  - ✓ Decreased coating cost
  - ✓ Decreased booth maintenance
  - ✓ Decreased emissions
  - ✓ Decreased waste disposal

Backside of part
Conventional Air Spray



Backside of part
E-Stat Air Atomizer

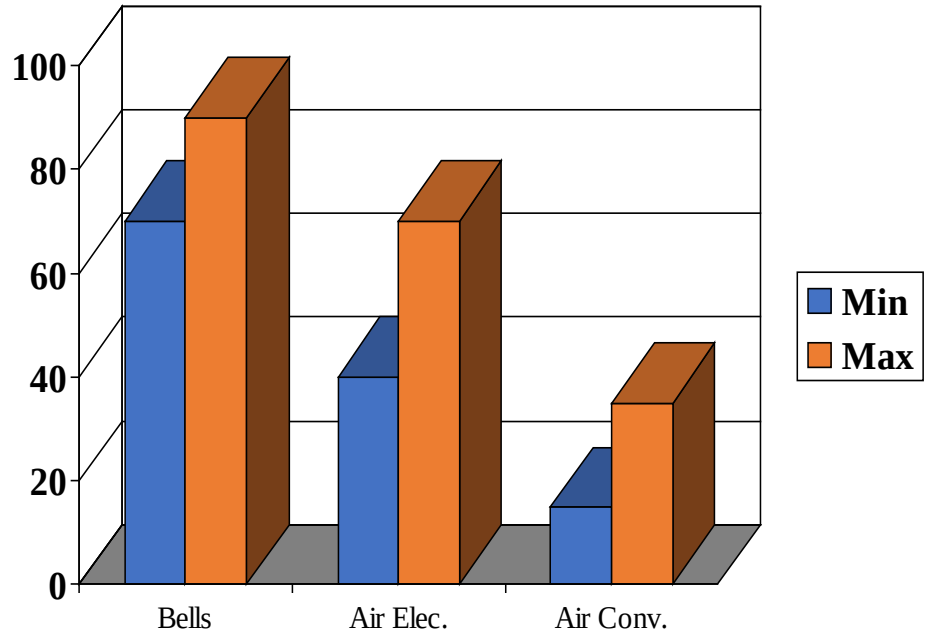


Backside of part
E-Stat Rotary Atomizer

Electrostatic Painting: Benefits

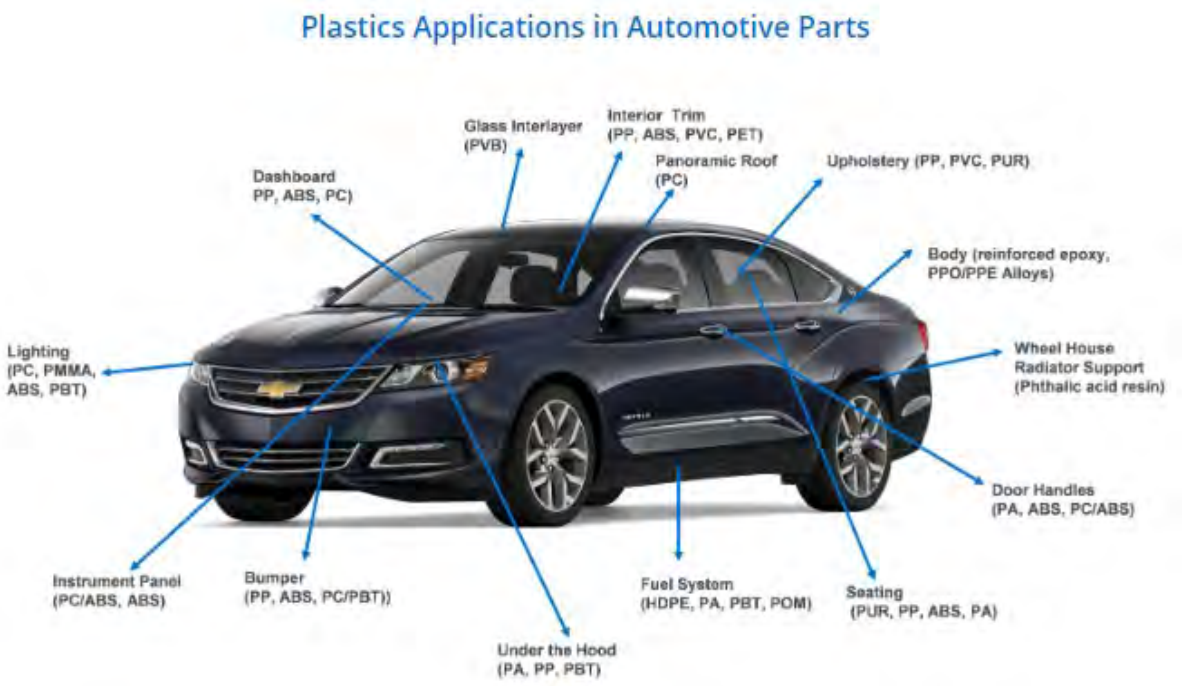
- The best way to reduce coating usage is to minimize the volume of material that is sprayed.

- You pay for paint 4 times!
  - ✓ You pay somebody to buy it
  - ✓ You pay somebody to apply it
  - ✓ You pay somebody to clean it up
  - ✓ You pay somebody to dispose of it



Typical Transfer Efficiency
on Metal Substrate

Coating Non-Conductors Electrostatically



Coating Non-Conductors Electrostatically

There are many techniques that can be used to make a non-conductive substrate conductive.

1. Conductive Sensitizers
2. Conductive Primers
3. Conductive Adhesion Promoters
4. Inherent Conductivity (moisture content)
5. Misting
6. Imaging Techniques
7. Conductive Additives
8. Metal Deposition

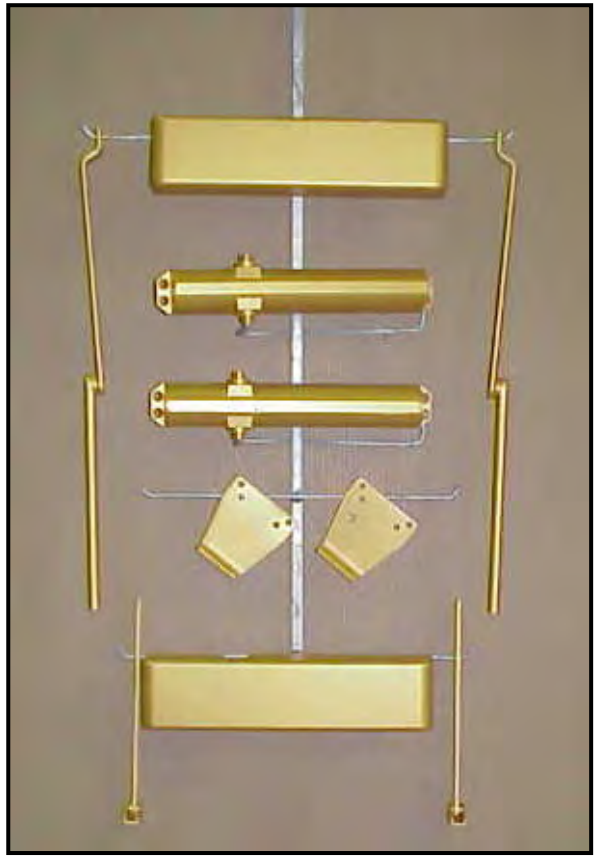
1. Conductive Sensitizers

A conductive sensitizer or “Prep Coat” is supplied as a concentrate and is dissolved in water or solvent at a rate of 0.5 - 8%. It can be applied by spraying, misting, wiping, or flow coating.

- The sensitizer forms an ultra thin molecular coating on the surface of the part which absorbs moisture from the air.
- The sensitizer is absorbed and expelled during the curing process.
- Physical properties should be evaluated. For automotive type coatings adhesion may be negatively impacted.

1. Conductive Sensitizers

Conductive sensitizer are most commonly used on non-automotive type plastic parts and wood.



2. Conductive Primers

A conductive primer is used based on end-user specifications and substrate. It is used to promote adhesion and provide a smoother base surface for a high-quality finish.

- Spray applied to a thickness of .8 – 1.2 mils (20 – 30 microns) dry.
- Once cured, it becomes conductive and provides a good source of grounding for the electrostatic application of base and clear coat materials.
- Conductive primers can be applied electrostatically. As the surface “wets” out continuity to ground is established. Testing indicates 30% increase in dry film thickness with electrostatics.
- Resistivity of the material in liquid state must be evaluated to determine if electrostatic spray will work.
- Used on SMC and glass reinforced plastics.

3. Conductive Adhesion Promoters

A conductive adhesion promoter is used based on end-user specifications. It is used to provide adhesion between the substrate and coating materials.

- Spray applied to a thickness of .3 - .6 mils (7.5 – 16) microns dry.
- Once the carrier solvents “flash-off”, it becomes conductive and provides a good source of grounding for the electrostatic application of base and clear coat materials.

- Conductive adhesion promoters can be applied electrostatically. As the surface “wets” out continuity to ground is established. Testing indicates 30% increase in dry film thickness with electrostatics.
- Resistivity of the material in the liquid state must be evaluated to determine if electrostatic spray will work.
- Used on TPO, PP, ABS, PC, PPO

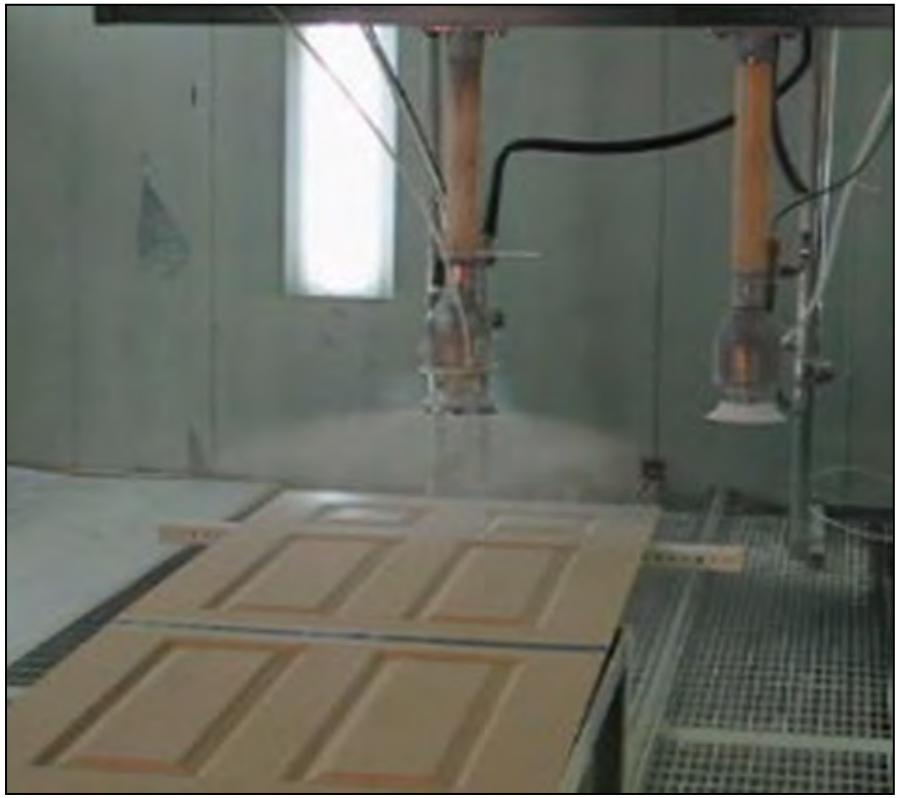
4. Inherent Conductivity

- Substrates such as wood or leather have a certain percentage of moisture which make them conductive.
- Typically, a moisture content of 7% or higher will provide electrostatic attraction.
- Relative humidity in the spray environment of 40% or higher will improve effectiveness.
- Variation in moisture content throughout substrate can yield inconsistent results.
- Water mist or conductive sensitizer often used to provide better uniformity.

4. Inherent Conductivity

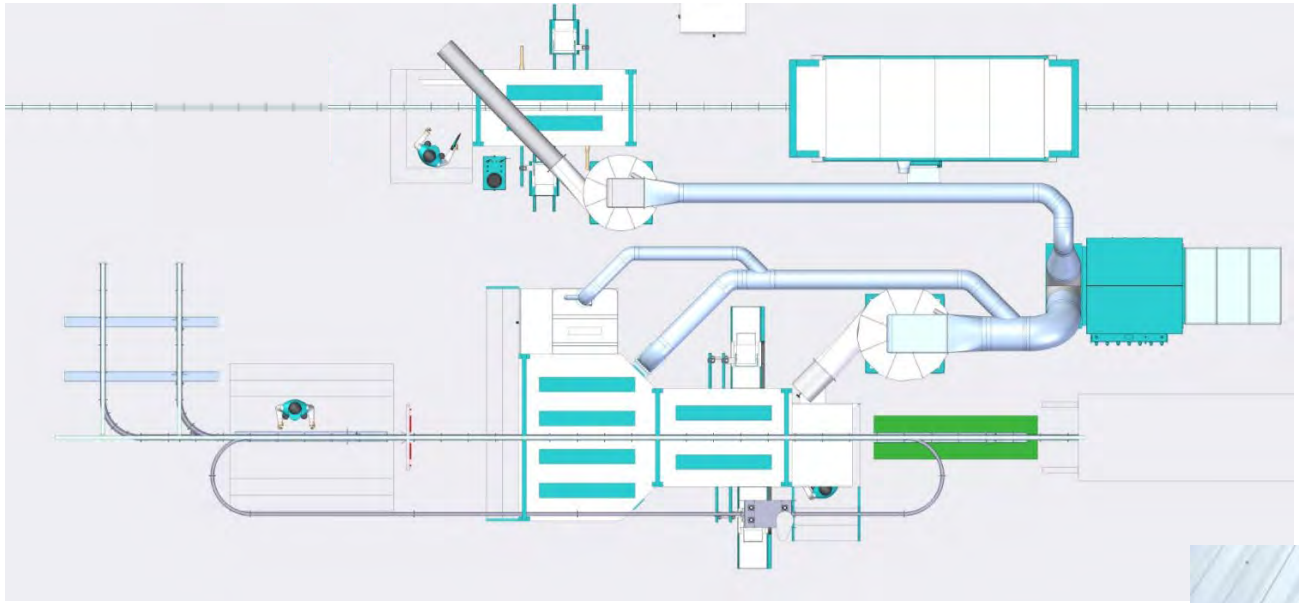
Rotary Atomizer used to apply 90% of coating

Electrostatic handgun used for manual reinforcement



TurboDisk used to apply waterborne coating to door.

4. Inherent Conductivity

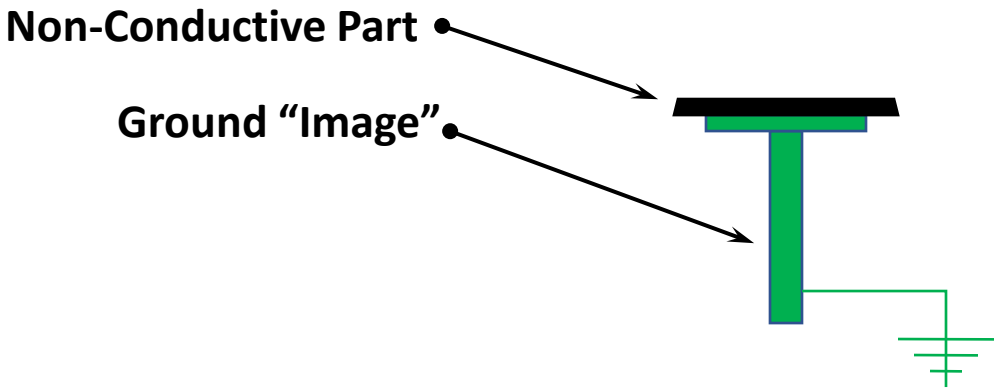


5. Misting

- Prior to the electrostatic application a light film (0.2 - 0.3 mils) of wet coating is applied to the surface of the parts.
- Electrostatic applicator (bell or gun) is then used to build remaining film thickness.
- Application of conductive primer on SMC substrate (as example).

6. Imaging Techniques

- Ground image is placed behind product being coated.
- Electrostatically charged particles are attracted to the ground image and the part gets in the way.
- Products coated using this technique:
  - ✓ Cosmetic Caps
  - ✓ Automotive Bumper Fascia
  - ✓ Papers, Films, Fabrics, Glass



6. Imaging Techniques

Metal plate placed behind paper web creates
“ground image” to promote electrostatic attraction

Metallic frame behind fascia provides
“ground image” to enhance electrostatic attraction

7. Conductive Additives

- Carbon powder (8 - 15%) or stainless-steel fibers (7 - 8%) have been added to thermoplastic materials to make them conductive.
- Conductive graphite fibrils are added at 2 - 3% by weight and produce sufficient conductivity for electrostatic attraction.
- Potential to eliminate primer if not required for adhesion.
- Often the increased cost of the conductive additives could not be justified to offset prior methods discussed and or additive negatively impacts physical properties of product.

8. Metal Deposition

- Vacuum Metalizing is the process of evaporating metals inside a vacuum chamber which then bonds to the substrate to achieve a uniform metalized layer.

- Metalizing is commonly used to apply chrome and metallic finishes for a wide variety of decorative applications including; cosmetic packaging, casket hardware, automotive interior components and appliance.

- Once a product is metalized, it provides a suitable target that can be grounded through the fixture for an electrostatic application.

- If the product is removed from the fixture that it was metalized on, ground may need to be reestablished.

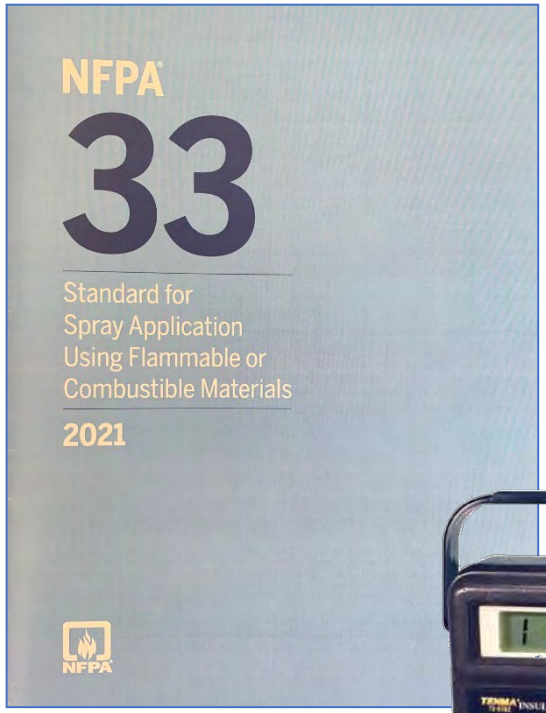
Coating Non-Conductors: Grounding

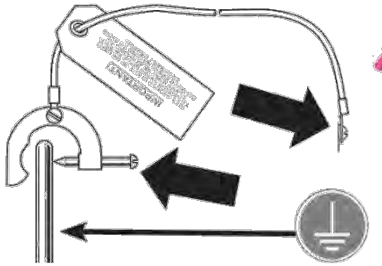
NFPA 33 (National Fire Protection Association)

11.3.4* All electrically conductive objects in the spray area, except those objects required by the process to be at high voltage, shall be electrically connected to ground with a resistance of not more than 1 meg-ohm (10^6 ohms). This requirement shall apply to containers of coating material, wash cans, guards, hose connectors, brackets, and any other electrically conductive objects or devices in the area. This requirement shall also apply to any personnel who enter the spray area.

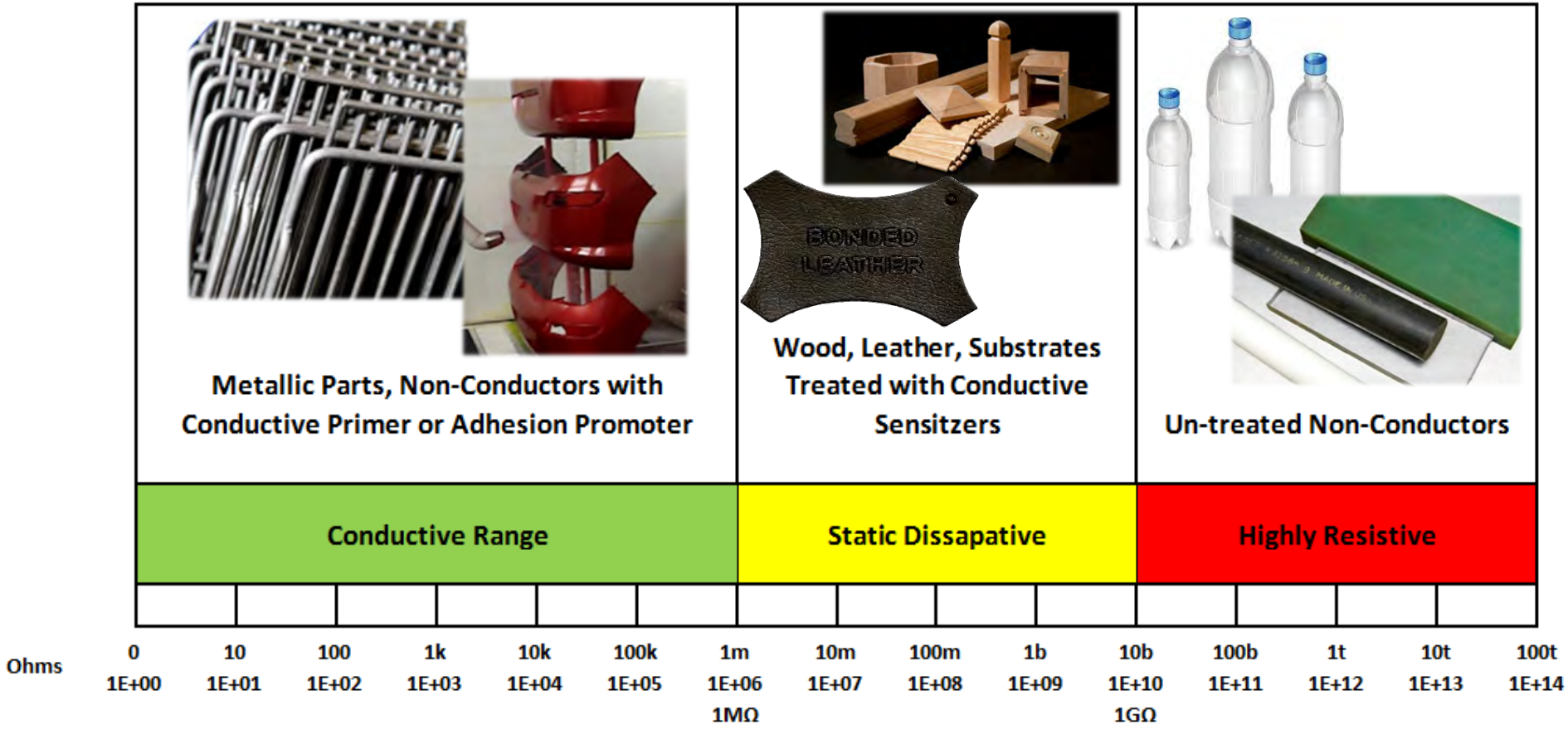
11.3.5 Conductive objects or material being coating shall be electrically connected to ground with resistance of not more than 1 meg-ohm (10^6 ohms). Areas of contact shall be sharp points or knife edges, where possible, and those areas of contact shall be protected from overspray, where practical.

11.3.6 Highly resistive objects (i.e., surface conductivity between 10^8 and 10^{11} ohms per square) that exhibit voltage below 2500 volts, as measured using a non-loading kilo-voltmeter and when subjected to coronal current not less than that expected in the application process, shall be considered adequately grounded.





Coating Non-Conductors: Grounding

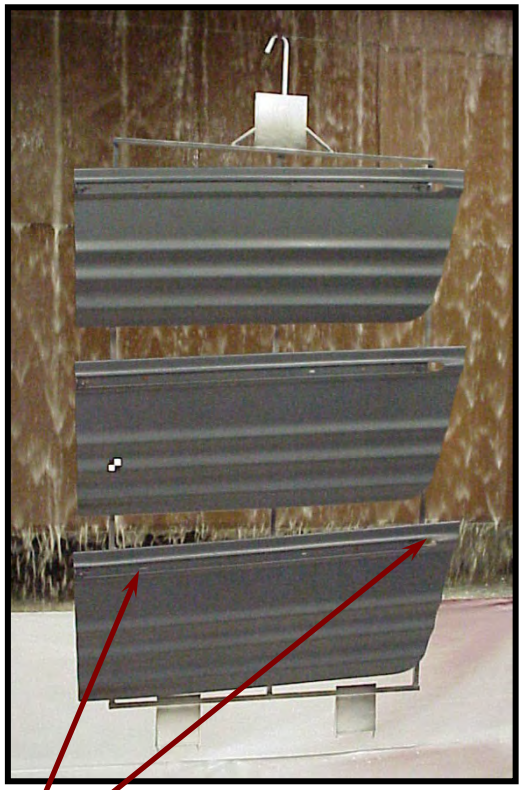


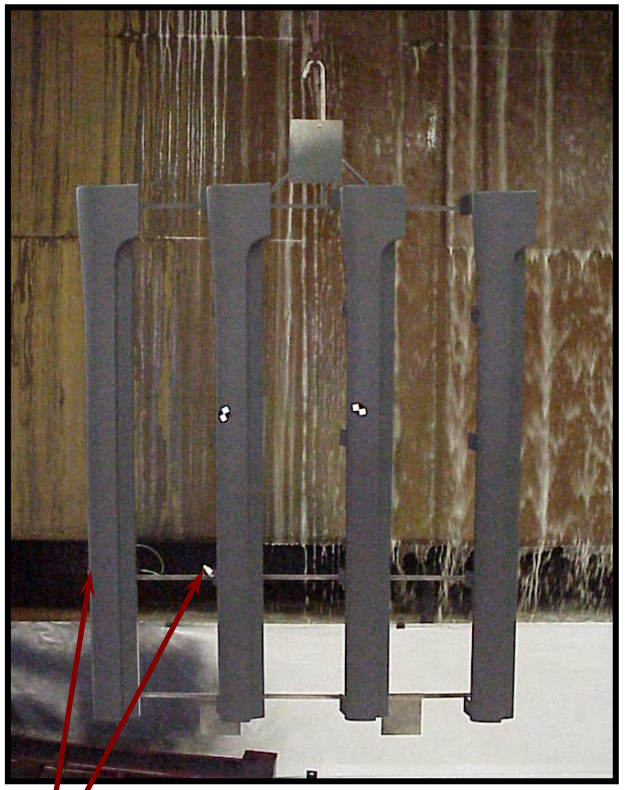
Ohm is unit of electrical resistance; every material has resistance.

- Copper has a low resistance, Wood has a high resistance

Resistance is a measure of how much an object opposes the passage of electrons (charge or current).

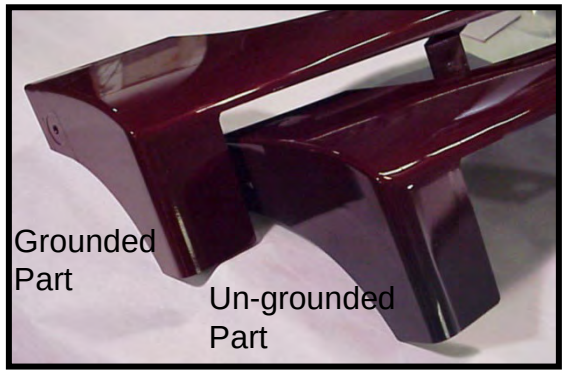
Coating Non-Conductors: Grounding

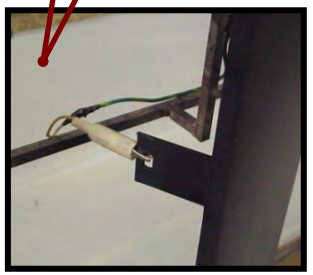




Grounded Part

Un-grounded Part



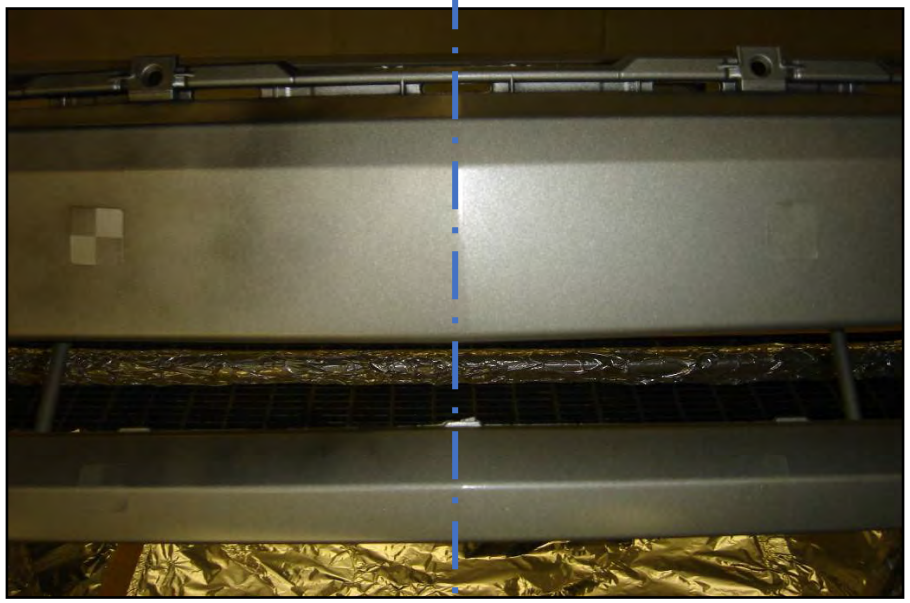


Good continuity between parts and hanger was obtained through design of fixture, clip is exposed to front and coated with adpro.

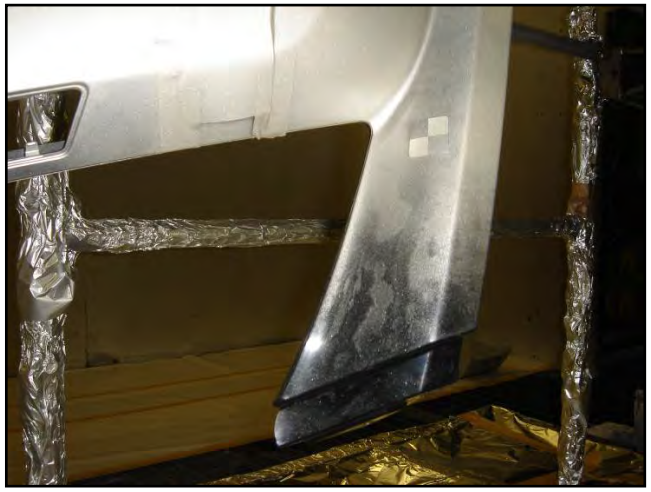
Ground clip was attached to parts to demonstrate increase coverage with properly grounded part. Adpro was also applied to back of parts in lieu of clip to promote continuity.

Coating Non-Conductors: Grounding

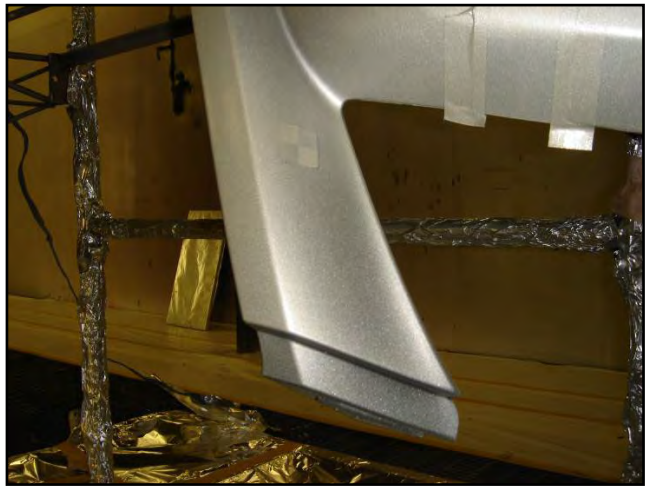
Non-Conductive Conductive



Foil Tape used to provide continuity between part and fixture



Non-Conductive

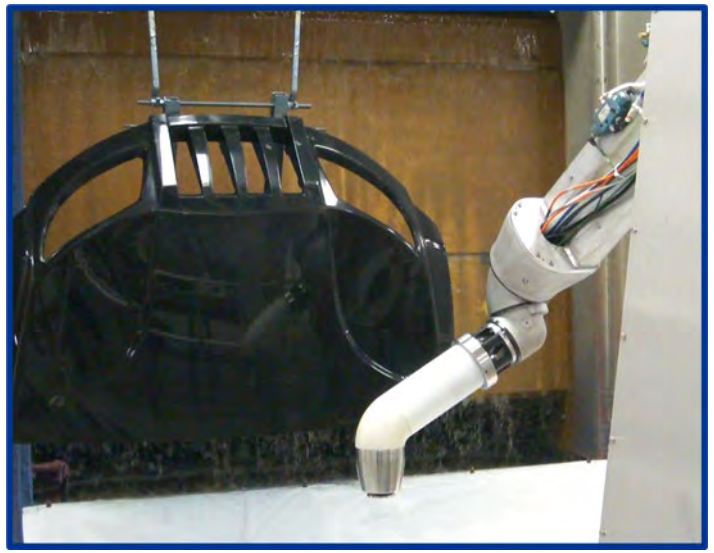


Conductive

Application Examples

Rotary atomizer used to replace air spray guns for primer \ adhesion promoter, base and clear coat applications.

	Existing Process			Proposed Process		
	Application Method	ml / part	Est. % TE	Application Method	ml / part	TE
Primer	Manual Spray Gun	228	35%	Robot / Rotary Atomizer, 0 kV	157	51%
Base Coat # 1	Manual Spray Gun	290	32%	Robot / Rotary Atomizer, 85 kV	142	69%
Base Coat # 2	Manual Spray Gun	195	27%	Robot / Rotary Atomizer, 65 kV	78	65%
Clear Coat # 1	Manual Spray Gun	290	31%	Robot / Rotary Atomizer, 85 kV	185	73%
Clear Coat # 2	Manual Spray Gun	290	31%	Robot / Rotary Atomizer, 85 kV	185	73%
Clear Coat # 3	Manual Spray Gun	290	31%	Not Required	N/A	N/A



Application Examples

Testing conducted to demonstrate transfer efficiency of rotary atomizer over air atomized applicator.

Base Coat Application on Bumper

	Application Method	ml / part	TE
1st Pass	Robot / Air Atomizer, 85 kV	116	52.6%
2nd Pass	Robot / Air Atomizer, 85 kV	70	

1st Pass	Robot / Rotary Atomizer, 85 kV	95	63.4%
2nd Pass	Robot / Air Atomizer, 85 kV	70	

1st Pass	Robot / Rotary Atomizer, 85 kV	95	72.9%
2nd Pass	Robot / Rotary Atomizer, 85 kV	52	

Coating Non-Conductors: Summary

- All these methods allow a manufacturer to coat non-conductors electrostatically and benefit from increased transfer efficiency.

- Often several of the techniques can be combined. Automotive bumpers are typically placed on cast aluminum bucks then coated with conductive adhesion promoter.

- The most important area to coat is the point on the work holder where ground contact is made with the product being coated.

- Electrostatics drastically increase transfer efficiency

1. Conductive Sensitizers
2. Conductive Primers
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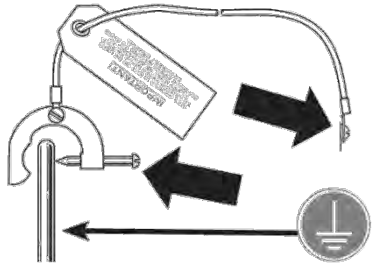

Thank you!

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