Coatings: Auto, Metal Parts and Products

Welcome To
Automotive Refinishing Surface Coatings and Metal Parts and Products

Course Overview
• Ozone and Human Health -- HAPS
• General Overview of Coating Ops
• Coating Composition & Emissions
• Pollution Prevention and Control
• Control Devices
• Rules & Regulations
• Inspections
• Calculations

Why Are We Here?
Ozone Causes:
Alveolar Injury Leading to Pulmonary Inflammation and Permanent Lung Damage
Respiratory Discomfort to Sensitive Populations
$330 Million in Crop Damage Each Year
Damage & Failure of Paints and Rubber Parts
Coating Market Segments

- **OEM Product Coatings**
  - Automotive
  - Marine
  - Aircraft
  - Metal Containers
  - Appliances
  - Machinery and Equipment
  - Wood Furniture
  - Plastics
  - Coil
  - Overprint

- **Architectural Paints**
  - Interior
  - Exterior

- **Special Purpose**
  - Industrial Maintenance
  - Traffic Paint
  - Auto Refinish

- **Miscellaneous**
  - Roof, Tank, Deck
  - Concrete

Comparison of Automotive vs. Metal Parts

- More Steps/Coats
- Less Steps
- Basically One Type of Application
- Many Application Types
- Booth or Outdoors
- Booth
- Looks Are Everything
- Corrosion Resistance
- Looks Are Everything
What Are Metal Parts?
• Motor Vehicle Parts and Accessories
• Recreational Vehicles
• Heavy Duty Trucks
• Railroad Cars
• Bicycles and Sporting Goods
• Extruded Aluminum

• Structural Components
• Medical Equipment
• Lawn and Garden Equipment
• Electronic Equipment
• Magnet Wire
• Steel Drums
• Industrial Machinery
• Metal Pipes

What is a Coating?
A thin film of organic material adhering to a mechanical device to protect it from corrosion or degradation by its environment. Consequently the color and texture of the surface are also altered.

What Kinds of Coating?
• Topcoat
• Undercoat
• Primer
• Sealer
• Surfacer
New Car Coating Process

A Coating System

Substrate: Metal, Plastic or other

Topcoat
Compatibility Intercoat
Primer/Sealer/Surfacer
Powder

1 to 5 mils each

REFINISHING
Refinishing is the coating of vehicles, their exterior parts or components, or mobile equipment, including partial body collision repairs for the purpose of protection or beautification and which is subsequent to the coating applied at the manufacturers’ assembly line.

— EPA
Refinish Coating Manufacturers

- BASF InMont
- DuPont
- PPG/Ditzler
- Sherwin Williams
- Glasurit
- Sikkens

More than 65,000 Formulations for 13,000 Colors!!

Special Features of Auto Refinishing

- Color Matching
- Sun and Weather Exposure
- Extreme Aesthetic Standards
- No Oven Curing

Metal
- White Primer
- Grey Intercoat
- Topcoat

Bondo Plastic
- Putty (dent filler)

Plastic & Fiberglass Body Parts
Color Matching

What’s in a Coating?

Four components of any coating:

Binder aka Resin Pigment Solvents Additives

BINDER

- Natural or Synthetic Resin
- Will Harden on Cue (Evaporation)
- Most Often a Plastic
Common Binders
- Nitrocellulose
- Acrylics
- Alkyds
- Polyurethanes
- Epoxies

PIGMENTS
- Small Hard Particles added for:
  - Color
  - Strength
  - UV Protection

SOLVENTS, DILUENTS AND THINNERS
Liquids Added To:
- "Dissolve" Binder
- Adjust Viscosity
- Promote Adherence
- Promote Flow
- Drying & Curing
ADDITIVES

Material Introduced For:
• Specific Effect on either Wet or Dry Film
• Less than 5% of total coating mass
• May or May Not Evaporate with solvent

VOC Control Strategies for Coatings

Use Reduction
• Use of Exempt Solvents
• Use of Water-Borne Products
• Increased Solids Contents
• Increased Transfer Efficiency

Retrofit Control Devices
• Capture and Reuse
• Capture and Destroy
Rule Provisions: Automotive Refinishing and Metal Parts

- Transfer Efficiency (T.E.) Provision
- Spray Booth Requirement (PM)
- VOC Coating Content Limits
- Open Container Limits
- Clean Up

Coating Type Formulations

<table>
<thead>
<tr>
<th>Coating</th>
<th>% Organic Solvent</th>
<th>% Water</th>
<th>% Solids*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent-Borne</td>
<td>~75</td>
<td>0</td>
<td>~25</td>
</tr>
<tr>
<td>High-Solids</td>
<td>&lt; 40</td>
<td>0</td>
<td>60 - 80</td>
</tr>
<tr>
<td>Waterborne</td>
<td>0 - 20</td>
<td>&lt; 80</td>
<td>50 - 100</td>
</tr>
<tr>
<td>Powder Coats</td>
<td>0 - 5</td>
<td>0</td>
<td>&gt; 95</td>
</tr>
</tbody>
</table>

*Solids include: Binders, Pigments & Additives

Exempt Solvents*

- Vary by Agency Definition
- Have a Variety of Human Health Effects Including Anesthesia and Intoxication
- Stratospheric Ozone Depletion
- Sometimes Incompatible with Aluminum or Water

*Negligibly Photochemically Reactivity
Waterborne Coatings

- Provide:
  - Solvent Penetration Protection
  - Low VOC
  - Reduced Fire Insurance
  - Easy Clean-up
- Require:
  - Careful Surface Prep
  - Temp. & Humidity Control While Curing
  - or Longer Drying Times
  - Stainless Steel Equipment

Difficulties for Waterborne Metallic Topcoats

- Hydrogen Evolution
- Flake Orientation (Critical Dry Times)

Water as a Diluent

- Organic Solvents
- Co-solvent
- Solvents
- WATER

x grams of solids covers area y

x grams of solids covers area y
**Co-Solvent**
(aka coupling agent)
Solvent that Causes Two Immiscible Liquids to Mix

May Comprise up to 30% of the Liquid in a Waterborne Coating

**Powder Coatings**

- Thermoplastic or Thermoset
- No on-site Color Mixing
- Faraday Cage Effect
- Baked to Cure
- Electrostatic Application or Fluidized Bed Required

**Spray Application Methods**

- Airless
- Air-Atomized or “Conventional” Electrostatic
- Air-Assisted Airless
- HVLP (High-Volume Low-Pressure)
- Rotary Atomization - Turbobell
Transfer Efficiency (T.E.)
Percentage ratio of the weight of solids deposited on the substrate to the weight of solids actually used

Transfer Efficiency Variables
- Spray Equipment
- Shape of Part
- Ambient Temperature and Humidity
- Air Flow Rate in Spray Booth

Transfer Efficiency Variables
- Coating Chemistry
- Painter Training and Experience
- Paint Pressure and Air Pressure at Nozzle
Percent Transfer Efficiency

HVLP
Airless Electrostatic
Air - Assisted Airless Electrostatic
Air Electrostatic
Air - Assisted Airless
Airless Spray
Air Spray

65%

HVLP Transfer Efficiency Saves $$

Estimated Annual Savings on Paint Purchases and Disposal Costs

Gun Control

http://www.midwayusa.com/spraygun.htm
Gun Air Pressure Gauge. Can this Replace the Spray Cap Pressure Gauge?

HVLP Gun Manufacturers

SATA High end products with precision engineering and digitally controlled mechanisms.
DeVilbiss Age old industry standard spray gun. A wide range of models.
Sharpe American made, budget price.
Binks Another industry standard gun. Binks guns share a market niche with DeVilbiss.
Accuspray Only gun with a plastic body
Astro Pneumatic guns are modeled after higher priced models above.

Spray Gun Feed Options

Gravity Feed Suction/Siphon Cup Pressure Feed
Coating Steps and Points of Emission

- Abrasive Sanding or Blasting
- Surface Clean and Prep
- Primer & Topcoat Application
- Flash Off -- Drying
- Curing
- Touch Up
- Equipment Clean Up
Points of VOC Emission

- 90% of VOC Emissions

Surface Preparation
- Abrasive Sandblasting
- Body Filler (Auto)
- Cleaning/Degreasing
- Application Acid Etching

Surface Preparation
- Detergent Washing
- Sandblasting
- Filling and Sanding
VOC Emissions Automotive

US EPA's VOC's Emissions Estimate

- Top Coats: 55%
- Equipment Cleaning: 20%
- Undercoats: 17%
- Surface Prep: 8%

Curing

The Process in which Paint is Converted from Liquid to Solid

Curing and Coating Types

- Air Drying
- Lacquers
- Enamels
- Powder Coats
- High Solids
- Waterborne
More on Curing - Lacquer
- Cures by the Evaporation of the Solvent

More on Curing - Enamel
Cures by an Irreversible Chemical Reaction Involving Various Components or Atmospheric Water or Oxygen

Curing Methods
- Air dried
- Thermoset or Thermocure Baked Coating > 194°F
- Thermoplastic
- Radiation
### Curing Times

- Air dried: hours
- Oven Baked: minutes
- Epoxy Systems: minutes
- Ultraviolet (UV): seconds
- Electron Beam: < 1 second

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### Curing Types (cont.)

**Thermoset/Thermocure**
- Solid Resins
- Heated - melt and flow
- Cross-link to form Higher Molecular Weight Solid
- Remains Stable After Heating

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### Curing Types (cont.)

**Thermoplastic**
- A Polymer
- Liquid when Heated
- Freezes Glassy when Cooled
- No Cross-linking
- Re-melted, Re-molded, and Recycled
Oven Cured Temps

Automotive Ops Are Special

Forced Dry or Accelerated Drying with heat lamps

Is this a baked cure?

194° F
Regulatory Cutoff
Control Alternative

Rather than Meet VOC Limits a Source May:

• Collect at Least a Required Percent by Weight of Emissions

And

• Transport to a Central Device that Reduces Emissions at Least a Required Percent (Total Control = 85%)

Capture System Schematic

Booth Design

Air Flow  Particulate Collection
Downdraft  Water Wash
Sidedraft  Dry filter
Hood
VOC Control Techniques – Capture System

- Performance indicators
  - Enclosures (Spray Booths)
    - Face velocity
    - Differential pressure
    - Average face velocity and daily inspections
Baghouse for Powder Coater

REMEMBER Booth is for PM Only NOT VOC’s

VOC Control Equipment
Incineration
  Direct Flame – Thermal Oxidizer
  Catalytic Oxidizer
Carbon Adsorption
Condensation
Absorption
Applicable Rules

- Nuisance
- Visible Emissions
- Prohibitory & NSR
- HAPS
- Permits
- Fugitive Dust (PM)

Why NESHAP’s

- Hazardous Air Pollutants (HAPs)
- Toxic Air Contaminants (TACs)
  - Chromium
  - Cadmium
  - Lead
  - Manganese
NESHAPS Misc. Metal Parts

- A Major Source if More than 10 tons per year of any ONE Hazardous Air Pollutant or 25 tpy or more of any COMBINED HAPs
- The Operator Will be Subject to Maximum Achievable Control Technology (MACT)
- 40 CFR Part 63 for Misc. Metal Parts

General 1.9
High Performance 27.5
Magnet Wire 0.44
Rubber-to-Metal 6.8
Fluoropolymer 12.4

* also written in terms of kg HAP per liter of coating solids
This is for new sources, existing usually have higher allowances

6 HHHHHHH Rule Video
NESHAPS: Paint Stripping and Misc. Surface Coating Ops

- 40 CFR 63 Subpart HHHHHH
- Initial Notification by Jan. 10, 2010 for Existing Sources
- Jan. 9, 2008 for New Sources
- Exclusions (Military, labs, etc.)

HAPS AFFECTED

- Chromium
- Lead
- Manganese
- Nickel
- Methylene Chloride

HHHHHH Rule Provisions

Motor Vehicle and Misc. Surface Coatings

- Train/Certify ALL Painters
- Spray Booth Requirements
  - 98% Capture Efficiency
  - Enclosures - Auto Complete
More on Training

• Painters must be certified as completing training in proper spray application of surface coatings, setup and maintenance of spray equipment
  ➢ Except students of accredited surface coating training program who are under the direct supervision of an instructor who is certified

More on Training

• Training program must include:
  ➢ Spray gun equipment selection, set up, and operation
  ➢ Best spray technique for different types of coatings to improve transfer efficiency and minimize overspray
  ➢ Routine booth and filter maintenance, filter selection and installation
  ➢ Compliance with requirements of the NESHAP

More on Training

• Owner or operator must certify training of each person was completed
• Certification must include:
  ➢ List of personnel who are required to be trained, with name and job description
  ➢ Hands-on and classroom instruction, covering elements of training program at a minimum
  ➢ Description of methods used at completion of initial or refresher training to demonstrate successful completion
More on Booths

• Spray Booths and Prep Stations
  ➢ Booths and prep stations for complete
    motor vehicles or mobile equipment must
  ➢ Have full roof and four walls or side curtains,
    and operate at negative pressure;
  OR
  ➢ If sealed doors/openings + automatic
    pressure balancing system, booth operated
    at up to, but no more than, 0.05 inches w.c.g.
    positive pressure

More on Booths

• Spray Booths or Prep Stations
  ➢ Booths or prep stations for
    miscellaneous coating or vehicle sub-
    assemblies
  ➢ Have full roof, at least 3 complete walls or
    side curtains, and ventilated so air is drawn
    into the booth
  ➢ Roof and walls may have openings for
    conveyors

Recordkeeping

• Surface Coating
  ➢ Painter training certification
  ➢ Documentation of filter efficiency
  ➢ Copies of all notifications and reports required
  ➢ Records of any deviations from requirements in the rule,
    including date and time period it occurred, a description
    of deviation, and corrective actions taken
  ➢ If spray gun does not meet definition of acceptable
    technologies and has cup capacity at least 3.0 oz.,
    documentation from spray gun manufacturer that
    Administrator has determined equivalent transfer
    efficiency
Automotive Requirements

Prohibition of Non-Compliant Coatings
Prohibition of Specification
Reactive Organic Compound (ROC) Content Must be Listed on Either the Container or Product Spec. Sheet
All ROC Stored in Sealed Containers
Operator Must Maintain all Records Necessary to Determine Compliance
Specialty Coatings May Not Exceed 840 gm/ltr or 5% of Monthly Usage

Automotive Requirements

Coatings Must be Applied Using High-Volume Low-Pressure (HVLP) Equipment

OR

Agency Prohibitory Rules May Require Best Available Control Technology

Automotive Requirements

All Coating Application Usually in a Permitted Spray Booth
Inspections

Pre-Inspection

Obtain Inspection Forms
Permit Review and Check
Safety Equipment Check
Regulation Review
File Review
Meeting at Facility with Representative

Inspection Video
Look for Open Containers

Open Containers?

Good Housekeeping?
Inspection

Automated VOC tracking system

Solvents
- Used for Cleaning
  - Tar
  - Prep for Plastic
  - Removing Adhesive
Inspection
Do we need a spray cap pressure gauge?

Inspection
Acetone Reclaim System

Inspection
SAFETY-KLEEN Spray Gun Cleaner. Is this a covered or open container?
How The Gun Cleaner Works

Alternative Cleaning Solutions

Recordkeeping Review
- Longest Part of the Inspection
- Do They Keep Records?
- Check Permit Requirements
What is the VOC content of this coating?

1.1 lbs VOC

\[
\text{1.1 lbs VOC} \div (1 \text{ Gal} - .24 \text{ gal} - .24 \text{ gal}) = 2.1 \text{ lbs/gal}
\]

What is the HAP content of this coating?
1.1 lbs + 2.9 lbs (voc + exempts) = 11.1 lbs/gal

.36 gal

1.1 lbs + 2.9 lbs (voc + exempts) = 11.1 lbs/gal

1 – \left[\frac{2.9}{(2.9/.24)}\right] – \left[\frac{2.2}{(2.2/.24)}\right] – \left[\frac{1.1}{(1.1/.16)}\right]

A Real World Application
Time for Calculations

Coating VOC = 2.76 lbs/gal
Thinner VOC = 7.27 lbs/gal
Our Operator uses it at 1% Mixture Rate

Time for Calculations

7.27 X .01 = .0727 lbs/gal VOC @ 1% Mixture Ratio
2.76 lbs/gal x .99 = 2.73 + .0727 = 2.80 lbs/gal

Websites

• www.nmfrc.org/
• http://www.ccar-greenlink.org
• http://www.paintcenter.org/