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
### 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

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### 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.

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### What Kinds of Coating?
- Topcoat
- Undercoat
- Primer
- Sealer
- Surfacer
A Coating System

<table>
<thead>
<tr>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 5 mils each</td>
</tr>
<tr>
<td>Compatibility Intercoat</td>
</tr>
<tr>
<td>Primer/Sealer/Surfarer</td>
</tr>
<tr>
<td>Powder</td>
</tr>
</tbody>
</table>

Substrate: Metal, Plastic or other

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

Little Full Color Changes

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

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**PIGMENTS**

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

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**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

<table>
<thead>
<tr>
<th>Organic Solvents</th>
<th>WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids</td>
<td>Co-solvent</td>
</tr>
</tbody>
</table>

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

Percent 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
Electrostatic Spray Gun

Note: Charging Electrode

Electrostatic Spray Video

Powder Coating Gun

Maximum voltage at the tip of the electrode
Charged Particles
Applicator
Powder
Voltage
Electrostatic Wrap
Powder Coatings Video

Powder Coated Products

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**

- **Storage**
- **Mixing**
- **Drying**
- **Cleanup & Prep.**

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

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

Coatings

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

Curing Types (cont.)

Thermoset/Thermocure

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

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
Sidendraft  Dry filter
Hood
VOC Control Techniques – Capture System

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

Down Draft Spray Booth

Water Wash Spray Booth
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

### Coating

<table>
<thead>
<tr>
<th>Coating</th>
<th>lb. HAP / gal solids*</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>1.9</td>
</tr>
<tr>
<td>High Performance</td>
<td>27.5</td>
</tr>
<tr>
<td>Magnet Wire</td>
<td>0.44</td>
</tr>
<tr>
<td>Rubber-to-Metal</td>
<td>6.8</td>
</tr>
<tr>
<td>Fluoropolymer</td>
<td>12.4</td>
</tr>
</tbody>
</table>

* 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
Inspection

Look for Open Containers

Open Containers?

Good Housekeeping?
Speaking of Rags

Booth Inspection

Booth Inspection

Check Filters
Intake and Exhaust
Violation?

Check Filters. Dirty, Painted or Clogged?

Check Pressure Drop (Δp) Across Filters

Check Filters. Dirty, Painted or Clogged?

Inside the Mixing Room
Automated VOC tracking system

Inspection

Solvents
- Used for Cleaning
  - Tar
  - Prep for Plastic
  - Removing Adhesive
Inspection

Do we need a spray cap pressure gauge?

Acetone Reclaim System

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
Time for Calculations

What is the VOC content of this coating?

1.1 lbs VOC

\[
\frac{1.1 \text{ lbs VOC}}{(1 \text{ Gal} - 0.24 \text{ gal} - 0.24 \text{ gal})} = 2.1 \text{ lbs/gal}
\]

Time for Calculations

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

.36 gal

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/