Welcome To
Automotive Refinishing
Surface Coatings and
Metal Parts and Products

Coatings: Auto, 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
- Basically One Type of Application
- Booth or Outdoors
- Looks Are Everything

- Less Steps
- Many Application Types
- Booth
- 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

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
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
Solids
x grams of solids covers area y

WATER
Co-solvent
Solvents
Solids
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
Air Spray Video

HVLP? DeVilbiss Gun
AIR ATOMIZATION

HVLP Caps

Hole Size
HVLP Primer Conventional Air

Spray Cap Pressure Gauge
Digital Air Pressure Readout

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

Powder Coatings Video
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

- Series 1, Undercoats, 17, 17%
- Series 1, Equipment Cleaning, 20, 20%
- Series 1, Top Coats, 55, 55%
- Series 1, Surface Prep, 8, 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

EPA-625/2-77-009

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
- 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
Sidewash  Dry filter
Hood
Down Draft Spray Booth

Water Wash Spray Booth

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

CARB Course #299 – Theory & Application of Air Pollution Control Devices
Catalytic Oxidizer

Regenerative TO - RTO

MACT Case Study Video
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 MMMM for Misc. Metal Parts

NESHAPS Misc. Metal Parts
Coating                      lb. HAP / gal solids*
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
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
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?

Inspection

Check Pressure Drop \((\Delta p)\) 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
Do we need a spray cap pressure gauge?

Inspection

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

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

1 – (2.9/2.9/.24) – (2.2/2.2/.24) – (1.1/1.1/.16)

Websites

• www.epa.gov/ttn/atw/mactfnlalph.html
• www.arb.ca.gov/coatings/autorefin/autorefin.htm
• www.arb.ca.gov/coatings/autorefin/scm/factshtscm.pdf
• http://www.nmfre.org/
Websites Cont.

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

Questions?

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