NACT 231

Coatings: Auto, Metal Parts and Products

National Air Compliance Training Program

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?

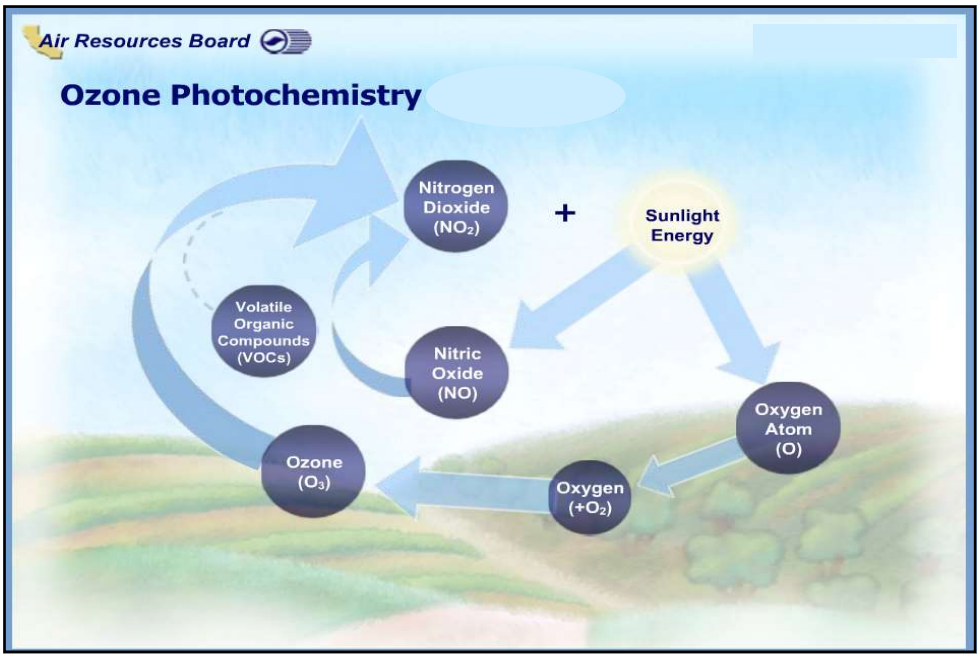
Ozone Causes:

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

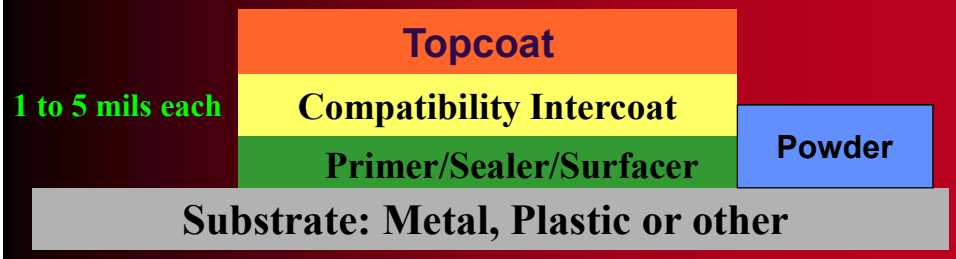
What is a Coating?

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



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!!

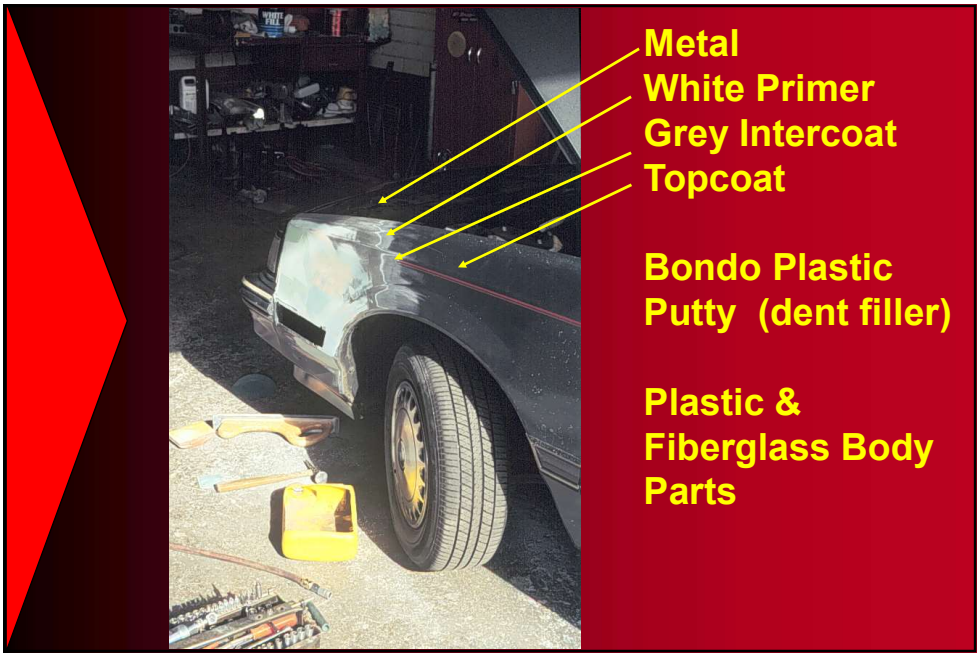
Special Features of Auto Refinishing

Color Matching

Sun and Weather Exposure

Extreme Aesthetic Standards

No Oven Curing



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


DUPONT
V-3661S
ACRYLIC LACQUER THINNER
Thinner


PPG
DITZ-O
Wax and Grease Remover
DX 440
ACRYLIC LACQUER PAINT REMOVER
DX 525
DANGER!
ONE GALLON

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**

Poll Questions 1 & 2

VOC Control Strategies for Coatings

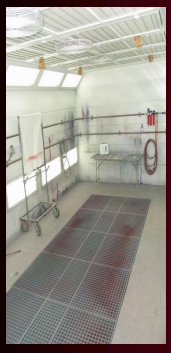
Use Reduction

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

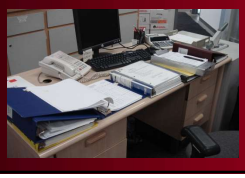
Retrofit Control Devices

- 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

Coating	% Organic Solvent	% Water	%Solids*
Solvent-Borne	~75	0	~ 25
High-Solids	< 40	0	60 - 80
Waterborne	0 - 20	< 80	50 - 100
Powder Coats	0 - 5	0	> 95

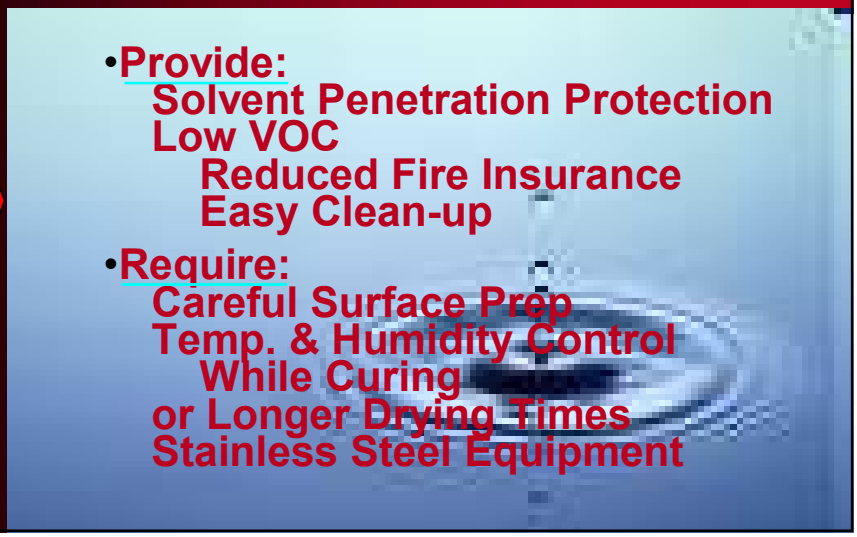
* Solids Include: Binders, Pigments & Additives

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

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

Process

Spray Application Methods

- Airless
- Air-Atomized or “Conventional”
- Electrostatic
- Air-Assisted Airless
- HVLP (High-Volume Low-Pressure)
- Rotary Atomization - Turbobell

203.2

Transfer Efficiency (T.E.)

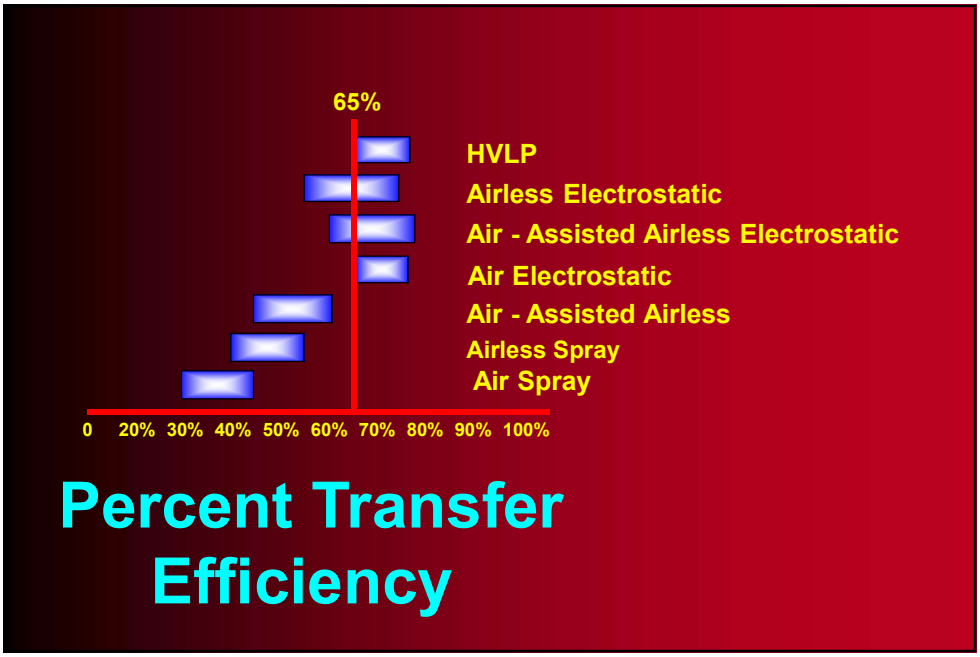
Percentage ratio of the weight of solids deposited on the substrate to the weight of solids actually used

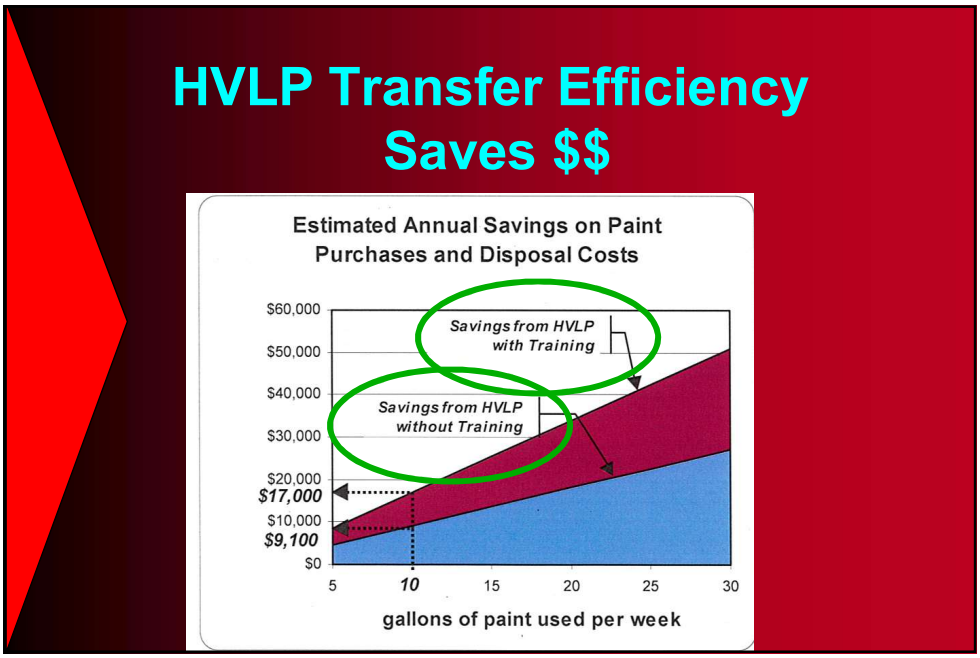
Transfer Efficiency Variables

- 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

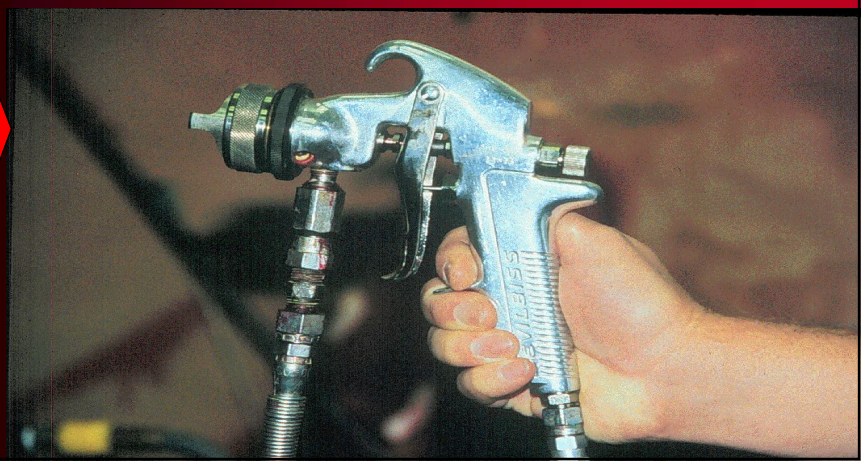

65%
HVLP
Airless Electrostatic
Air - Assisted Airless Electrostatic
Air Electrostatic
Air - Assisted Airless
Airless Spray
Air Spray
0 20% 30% 40% 50% 60% 70% 80% 90% 100%
Percent Transfer Efficiency


HVLP Transfer Efficiency Saves $$
Estimated Annual Savings on Paint Purchases and Disposal Costs
$60,000
$50,000
$40,000
$30,000
$20,000
$17,000
$10,000
$9,100
$0
Savings from HVLP with Training
Savings from HVLP without Training
5
10
15
20
25
30
gallons of paint used per week

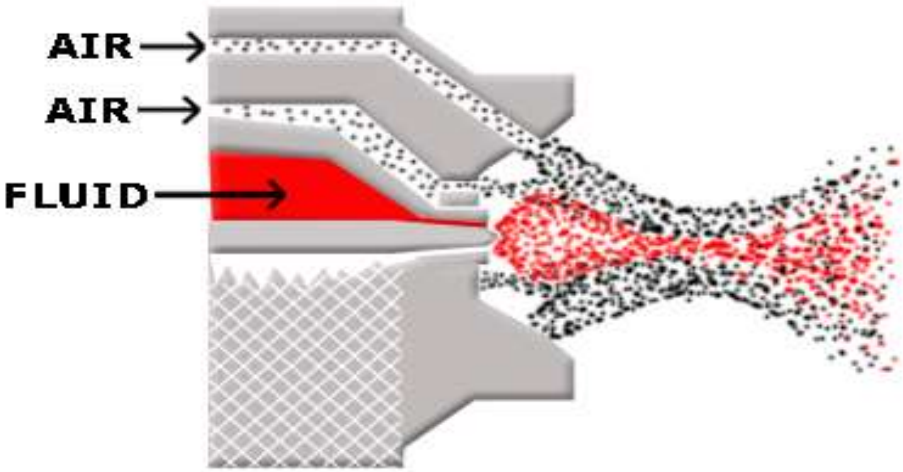
Gun Control

Air Spray Video

HVLP? DeVilbiss Gun



AIR ATOMIZATION



HVLP Caps

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

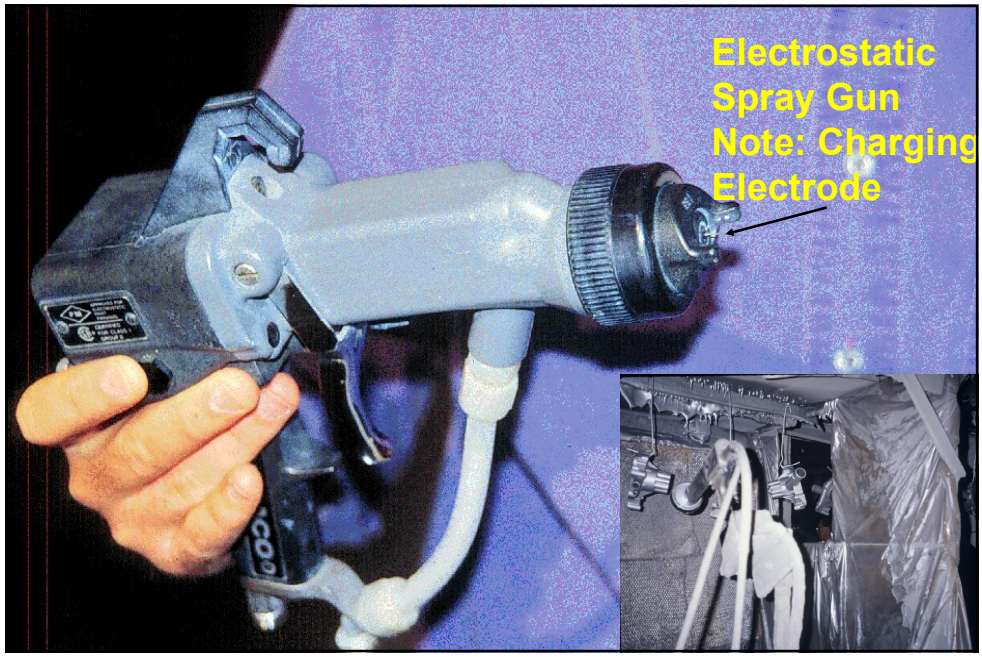
Astro Pneumatic guns are modeled after higher priced models above .

Spray Gun Feed Options

Gravity Feed

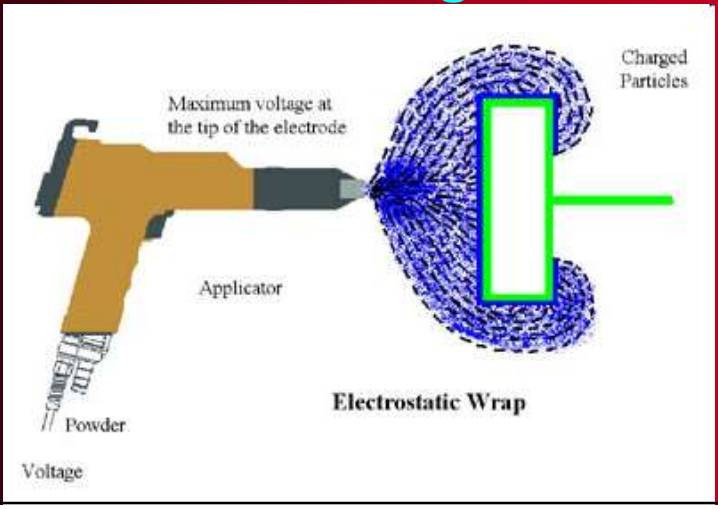
Suction/Siphon Cup

Pressure Feed



Electrostatic Spray Video

Powder Coating Gun



Powder Coatings Video

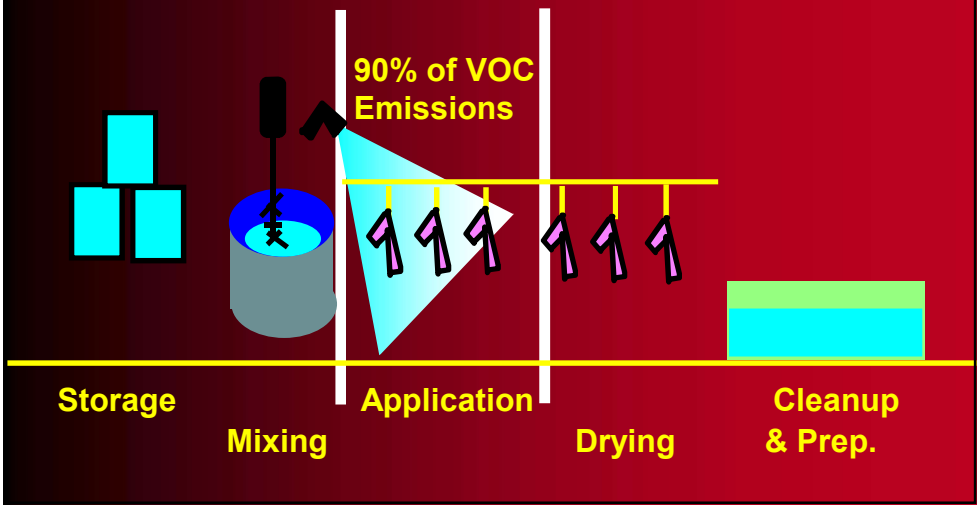
Powder Coated Products

Poll Questions 3 & 4

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

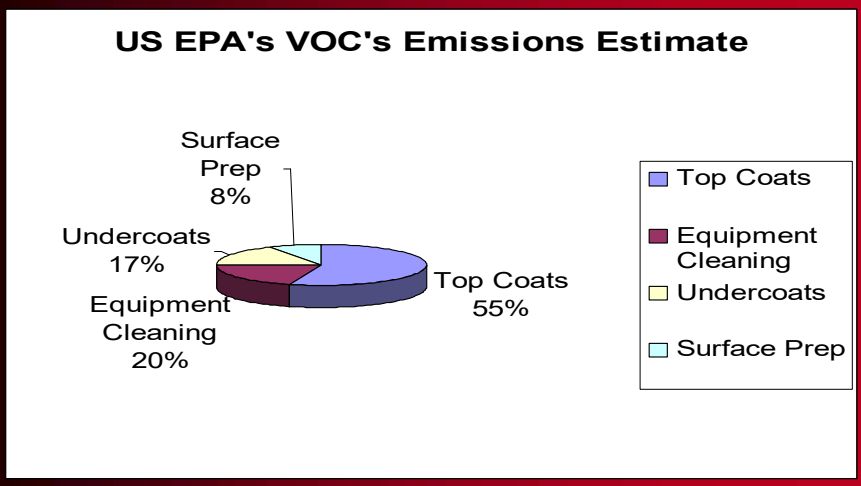


Surface Preparation

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

Surface Preparation

VOC Emissions Automotive



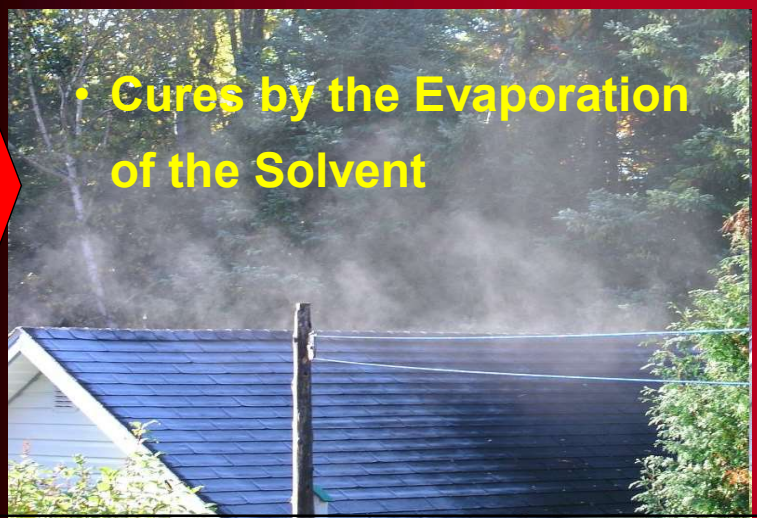
Curing

The Process in which Paint is Converted from Liquid to Solid

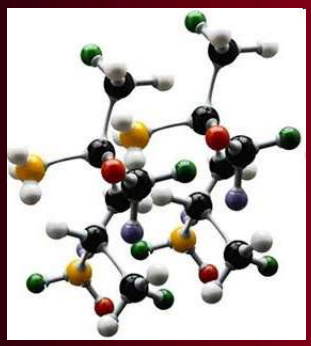
Curing and Coating Types

- Air Drying
- Lacquers
- Enamels
- Powder Coats
- High Solids
- Waterborne

More on Curing - Lacquer



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

202.2

Curing Times

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

EPA-625/3-77-009

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

Poll Questions 5 & 6

Control Alternative

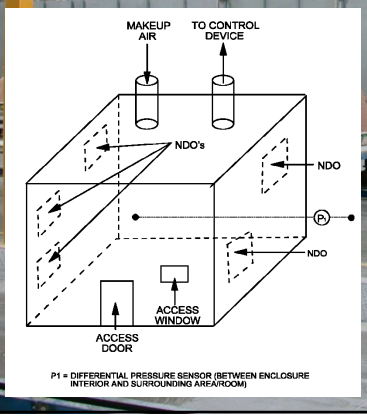
Rather than Meet VOC Limits a Source May:

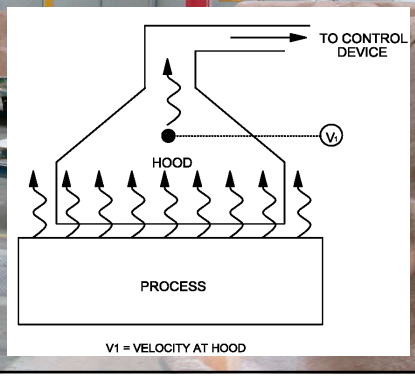
- **Collect at Least a Required Percent by Weight of Emissions**

And

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

Capture System Schematic





Booth Design

Air Flow

- Downdraft
- Sidedraft
- Hood

Particulate Collection

- Water Wash
- Dry filter

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

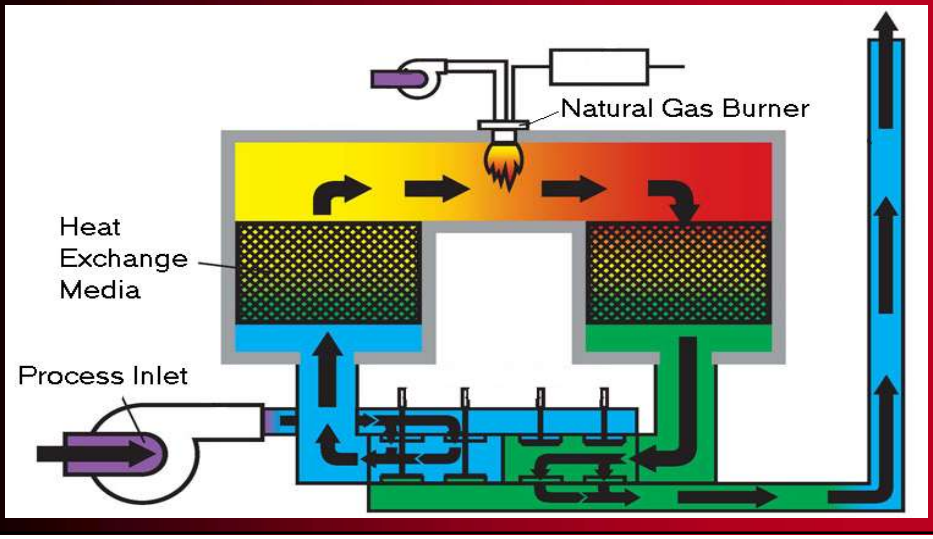
VOC Control Equipment

- Incineration
  - Direct Flame – Thermal Oxidizer
  - Catalytic Oxidizer
- Carbon Adsorption
- Condensation
- Absorption

NACT Course #299 – Theory & Application of Air Pollution Control Devices

Catalytic Oxidizer

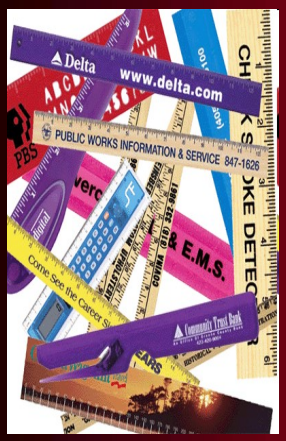
Regenerative TO - RTO



Poll Questions 7 & 8

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

6 HHHHHH Rule Video

NESHAPS: Paint Stripping and Misc. Surface Coating Ops at Area Sources

- 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

Possible SIP Automotive Req'ts

- 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

Possible SIP Automotive Requirements

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

OR

Agency Prohibitory Rules May Require Best Available Control Technology

Possible SIP Automotive Req'ts

All Coating Application Usually in a Permitted Spray Booth

Poll Questions 9 & 10

Inspections

Inspection

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

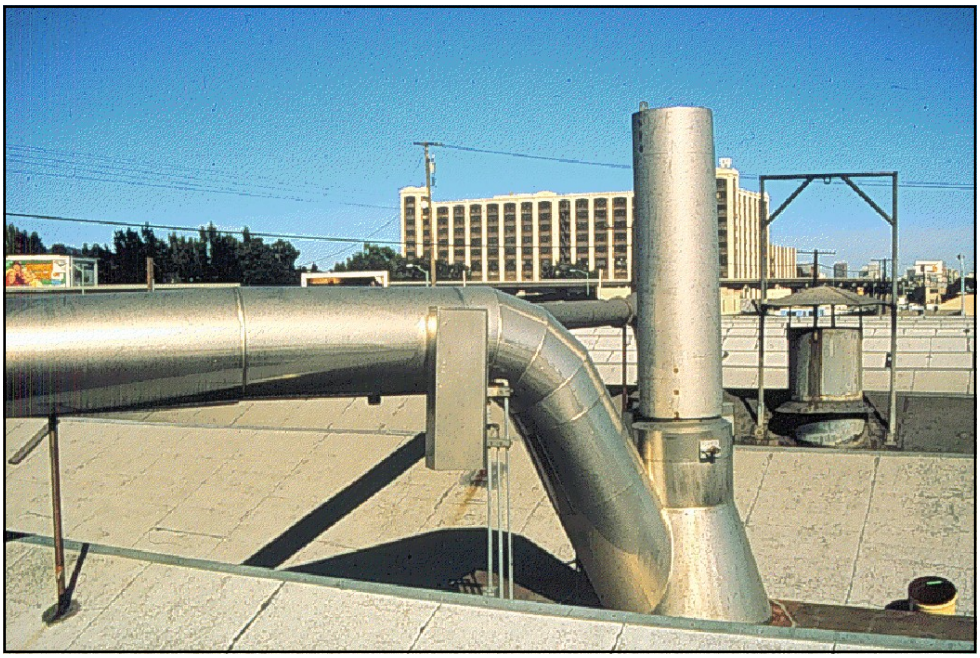
Violation?

Inspection

Check Pressure Drop
(Δp) Across Filters

Check Filters.
Dirty, Painted or Clogged?

Inside the Mixing Room



Inspection

Automated VOC tracking system

Solvents

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

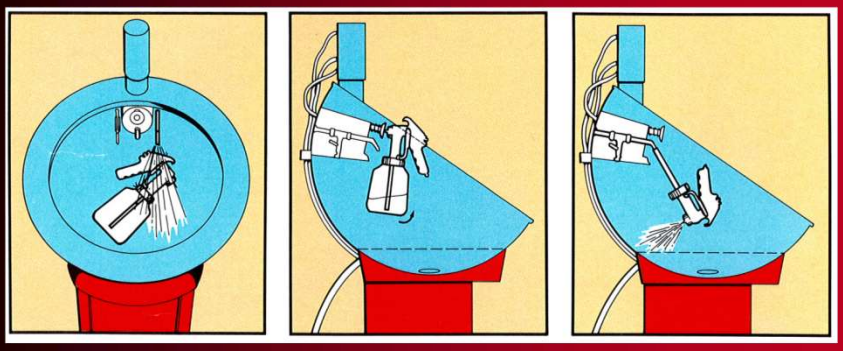
Inspection

Do we need a spray cap pressure gauge?

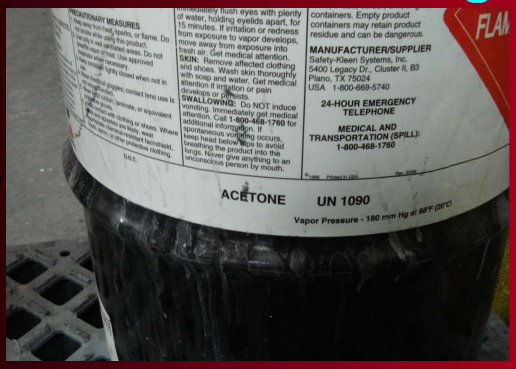
Inspection

SAFETY-KLEEN Spray Gun Cleaner.
Is this a covered or open container?

How The Gun Cleaner Works



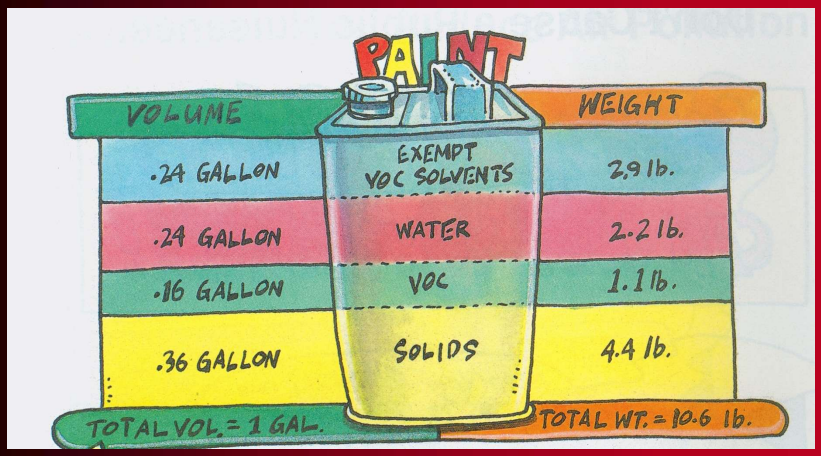
Alternative Cleaning Solutions



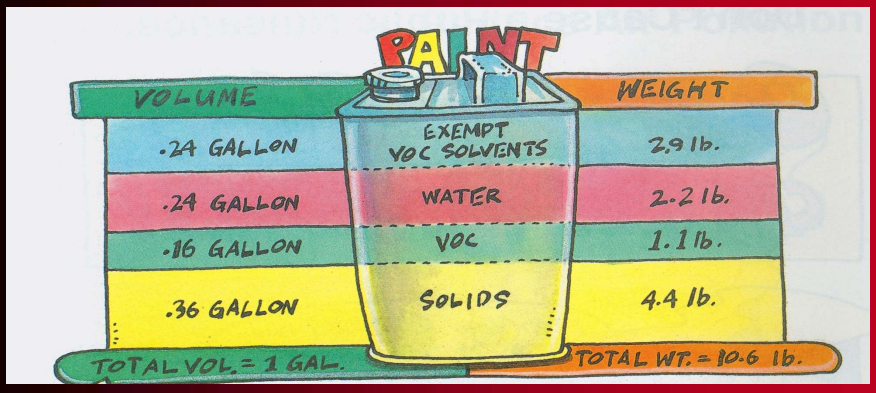
Recordkeeping Review

- Longest Part of the Inspection
- Do They Keep Records ?
- Check Permit Requirements

Time for Calculations

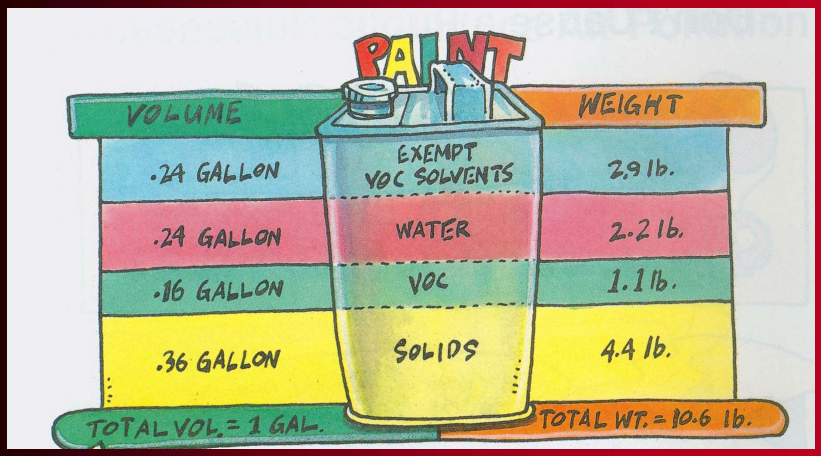


What is the VOC content of this coating?

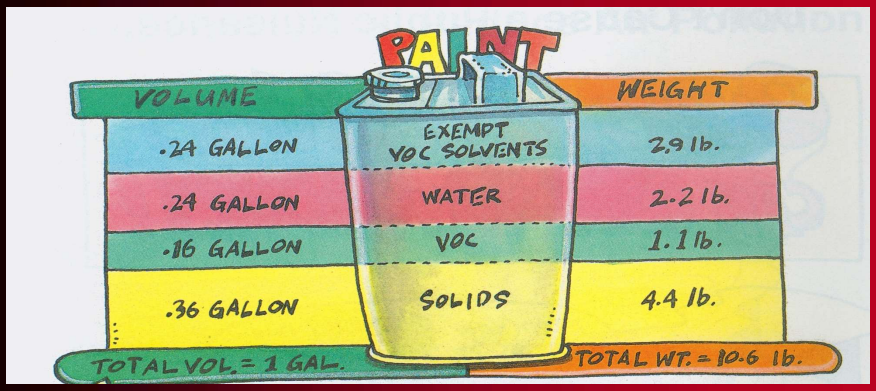


$$\frac{\text{1.1 lbs VOC}}{\text{(1 Gal - .24 gal - .24 gal)}} = \text{2.1 lbs/gal}$$

Time for Calculations

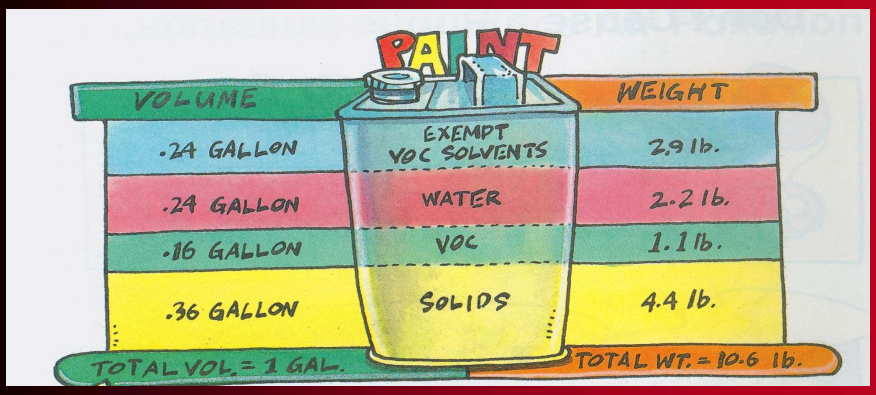


What is the HAP content of this coating?



1.1 lbs + 2.9 lbs (voc + exempts)

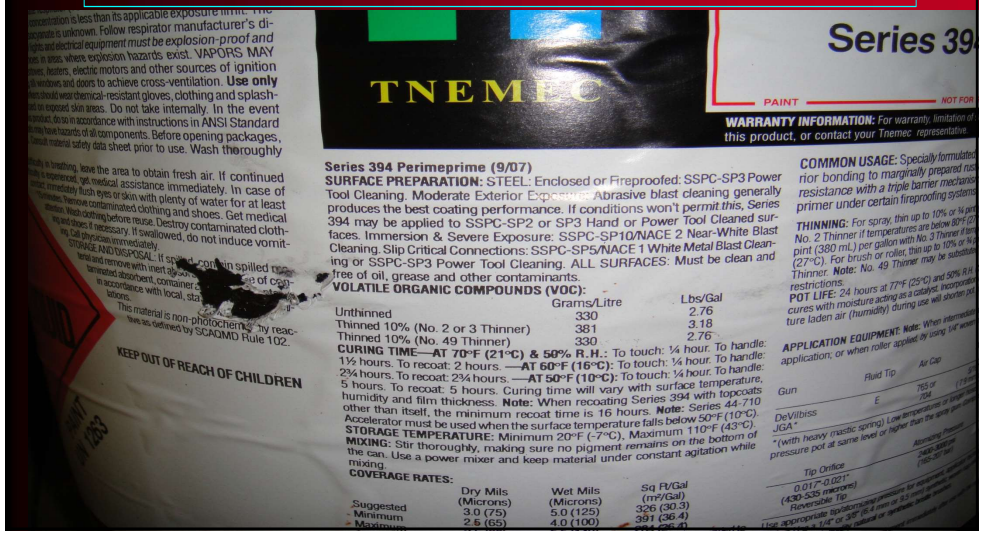
$$\frac{\text{1.1 lbs + 2.9 lbs (voc + exempts)}}{\text{.36 gal}} = \text{11.1 lbs/gal}$$



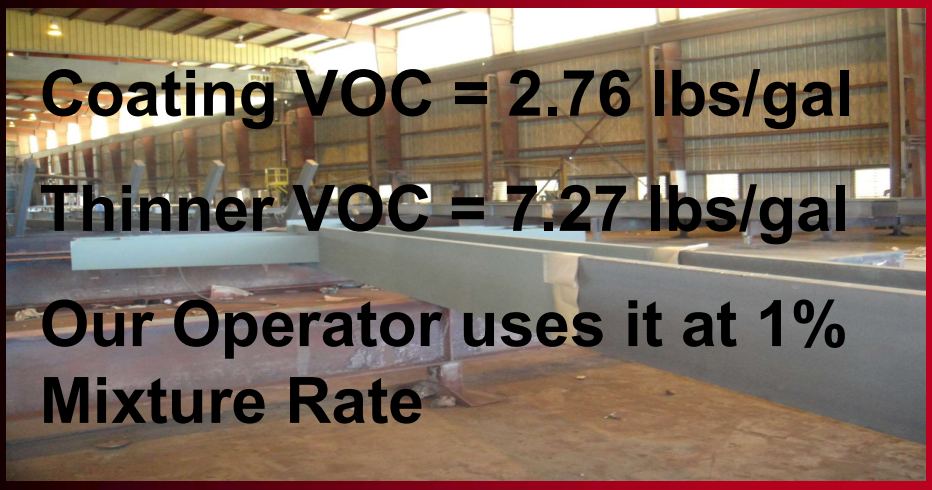
1.1 lbs + 2.9 lbs (voc + exempts)

$$\frac{}{1 - [2.9/(2.9/.24)] - [2.2/(2.2/.24)] - [1.1/(1.1/.16)]} = 11.1 \text{ lbs/gal}$$

A Real World Application



Time for Calculations



Coating VOC = 2.76 lbs/gal

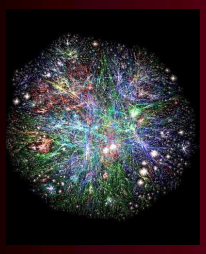
Thinner VOC = 7.27 lbs/gal

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

- epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-9
- epa.gov/collision-repair-campaign
- nmfrc.org/
- ccar-greenlink.org
- paintcenter.org/

Questions?