Solvent Cleaning: Degreasing Operations NACT 233

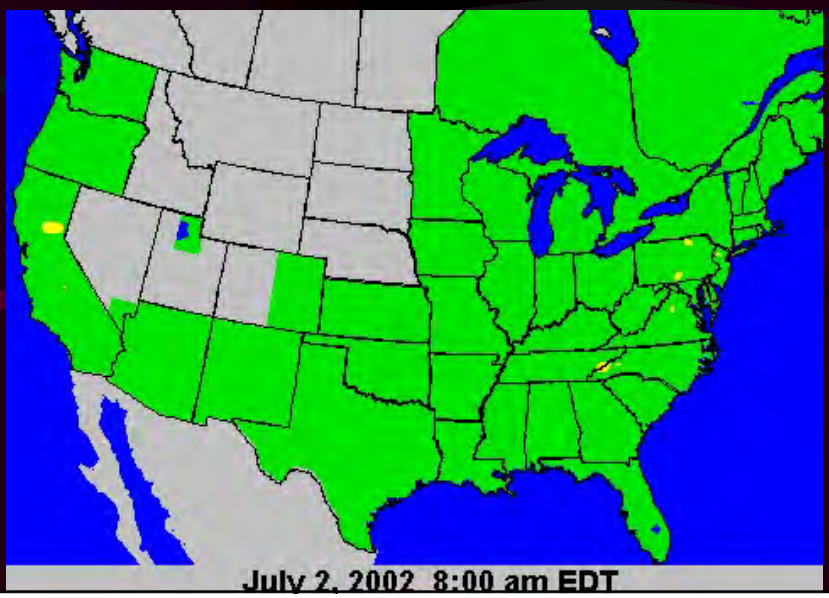
What This Class Is About

- Descriptions Of The Solvents
- Descriptions Of The Solvent Process
- Regulation Requirements
- Inspection Procedures

Why Are We Interested?

- Solvents Emissions In California
- California Clean Air Act
- Air Pollution Health Concerns
- Ozone Problems

OZONE Formation



Soil Categories

- Organics
  - rosins,glycols,oils,greases,waxes
- Water Soluble Inorganic Salts
  - chlorides,sulfates,etc.
- Insoluble Particles
  - dirt,dust,metal fines, etc.

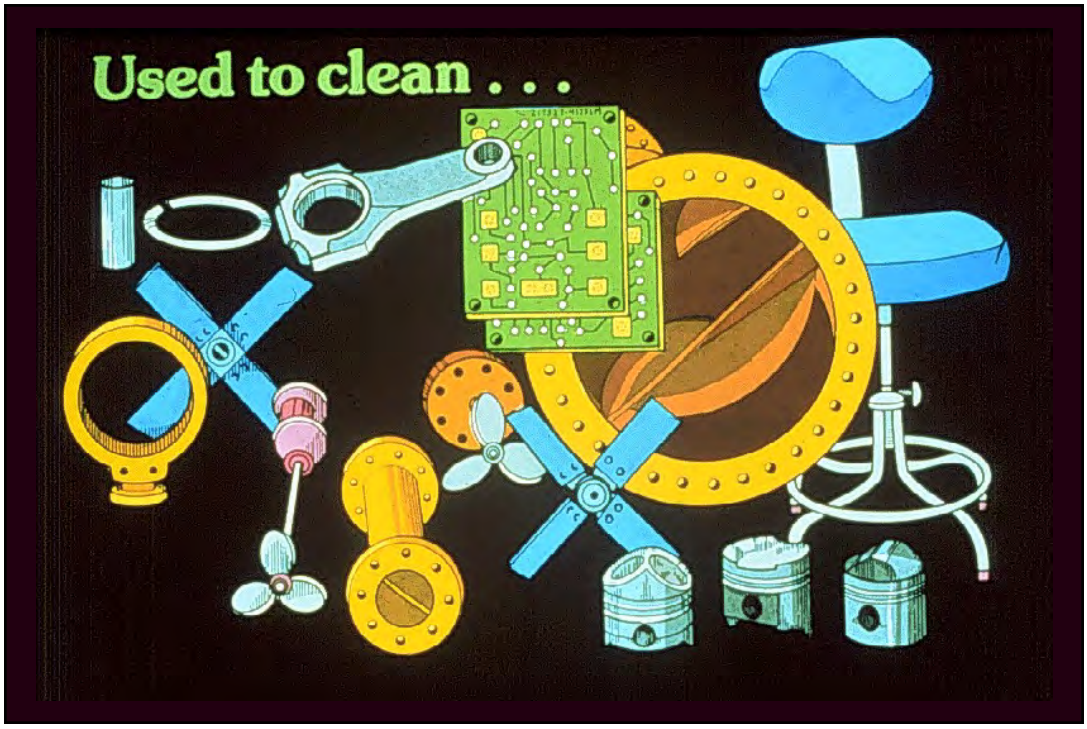
Switching To Aqueous or Semi-Aqueous Cleaners

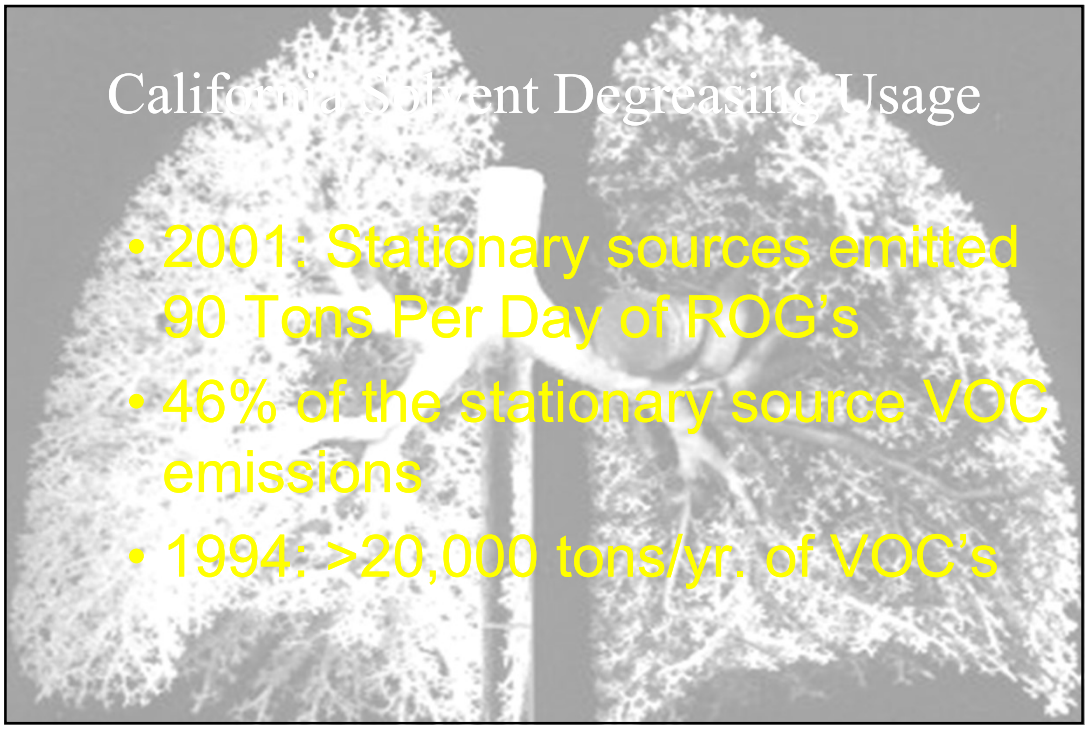
- Water-Based (Aqueous)
  - Alcohols
  - Alkaline Detergents
  - Surfactants
  - Saponifiers
- Citrus Based (Semi-Aqueous)
  - Terpenes
- Lower VOC Products
  - Hydrocarbons with Surfactants and Rust Inhibitors
  - Glycol Ethers
  - Acetone

Solvent Applications

- Metal Working
- Automotive
- Electronics
- Appliance
- Furniture
- Jewelry
- Plumbing
- Aircraft
- Refrigeration
- Business Machinery
- Fasteners
- Etc.

(pp 200-3)




California Solvent Degreasing Usage
• 2001: Stationary sources emitted 90 Tons Per Day of ROG's
• 46% of the stationary source VOC emissions
• 1994: >20,000 tons/yr. of VOC's


Storing Solvents
• Sealed Containers
• Properly Labeled
• No Leaks
• Protected Areas
• Hazardous Waste

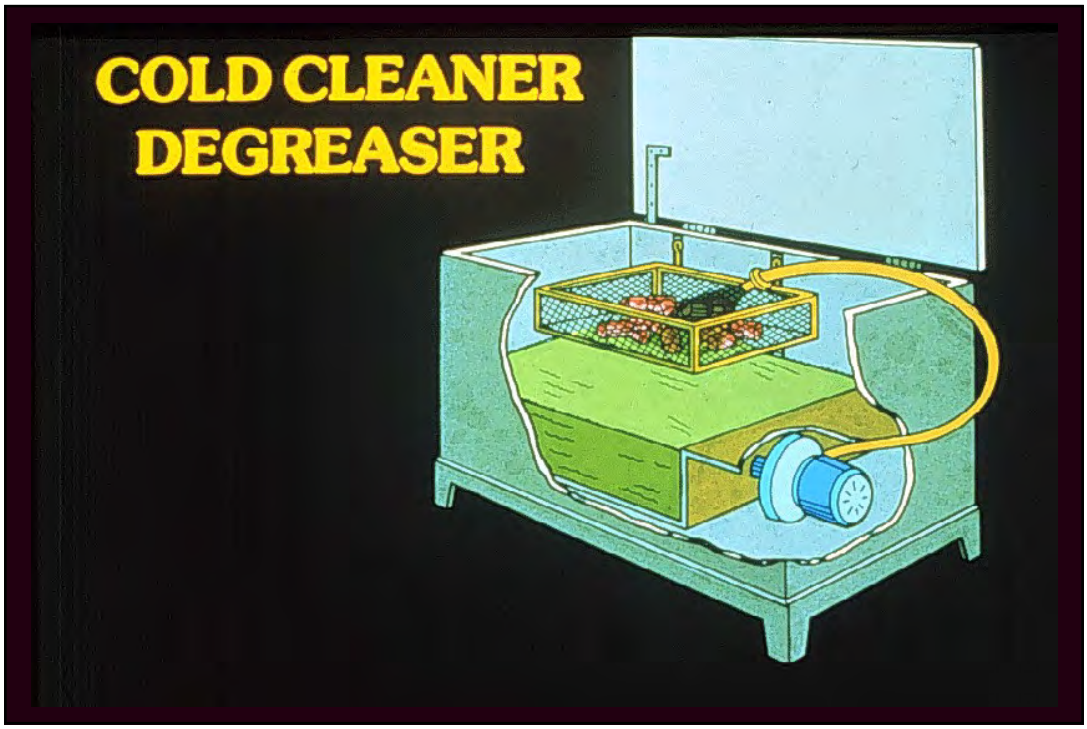
Solvent Cleaning Classifications

- Cold Cleaning
- Open Top Vapor Cleaning
- Conveyorized Cleaning

Cold Cleaning

- Uses All Types Of Solvents
- ~55%-60% Of Solvent Emissions
- Average Unit Emission: ~.3 TPY
- Includes
  - Spraying
  - Brushing
  - Flushing &
  - Immersion

(pp 300-1 & 2)


COLD CLEANER
DEGREASER

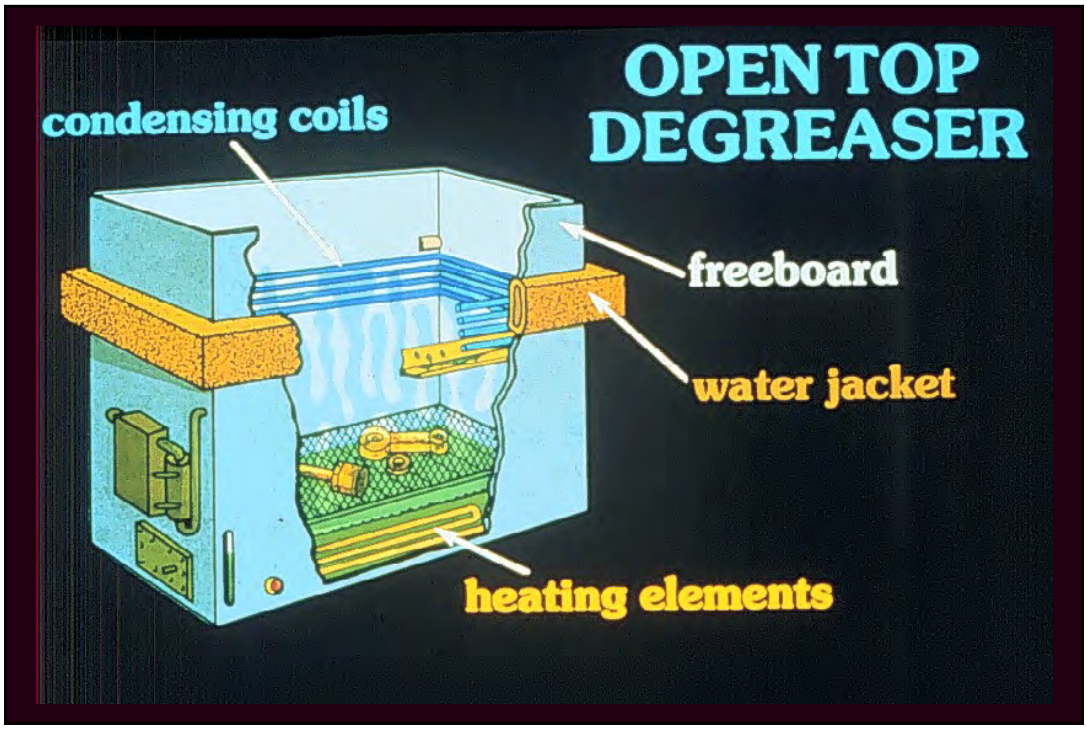

GRAYMILLS
CLEAN-O-MATIC
parts & equipment washer

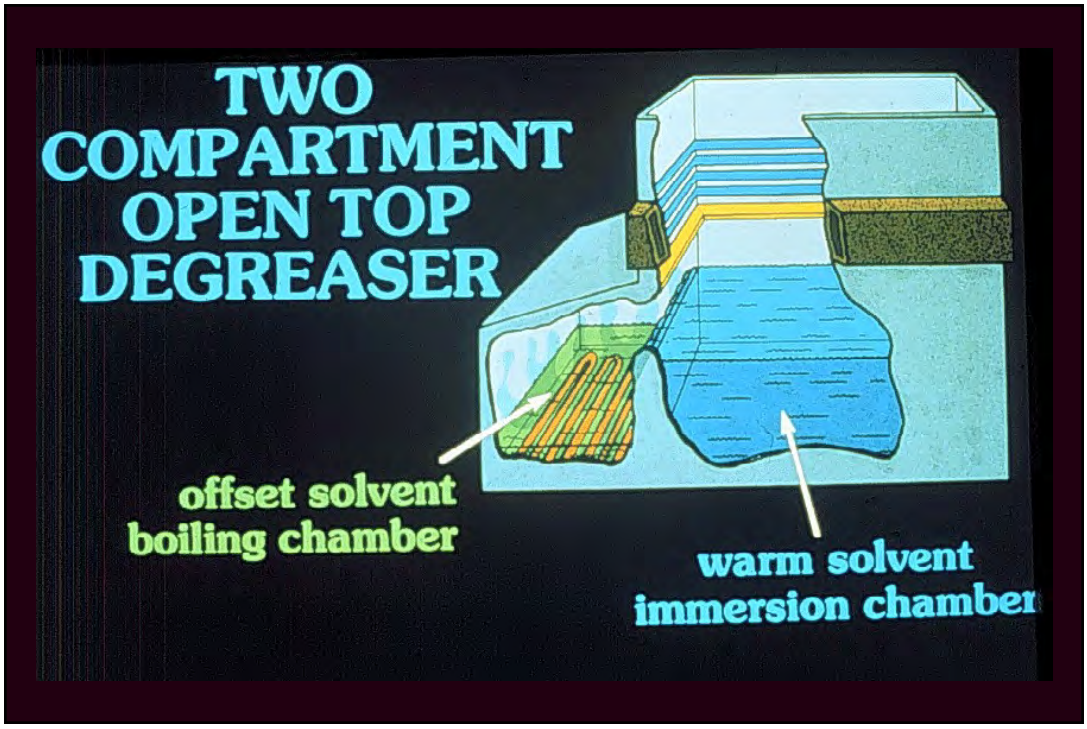
Wash Basin with Remote Reservoir

Open Top Vapor Cleaning

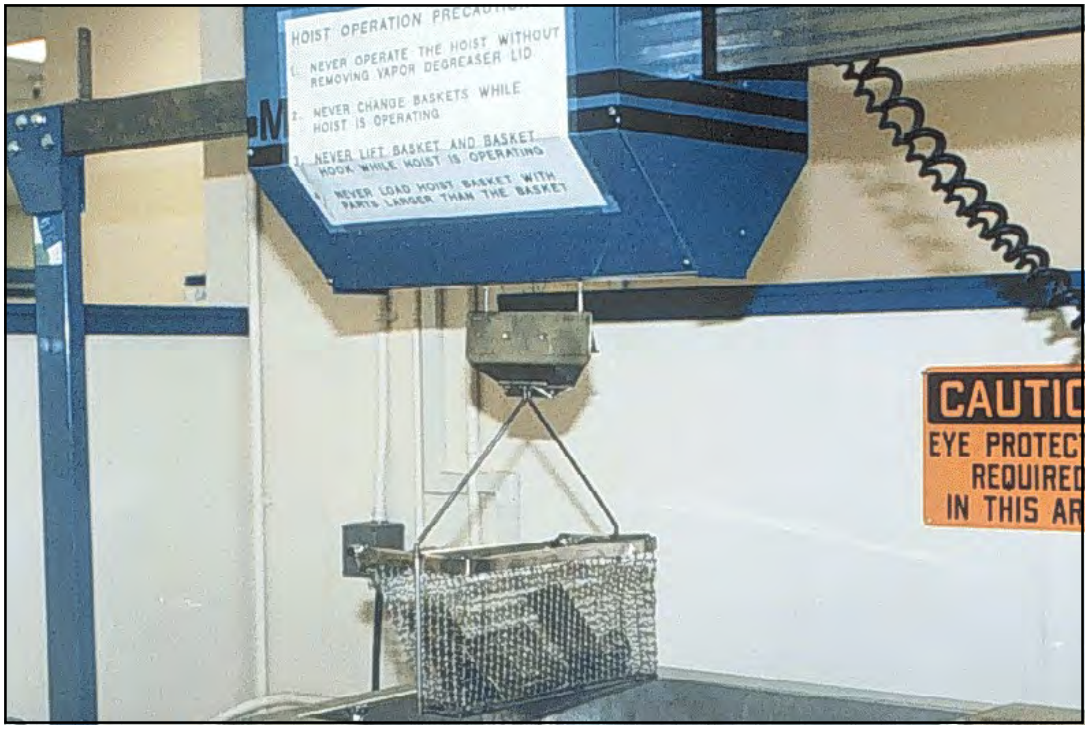
- Emit ~200,000 Metric Tons Or 30% Of The National Solvent Cleaning Emissions
- Are Batch Loaded
- Clean Through The Condensation Of Hot Solvent Vapor On Colder Parts
- >100,000 Tons/yr. Of Halogenated Solvents Are Used In This Type Of Cleaner In U.S.

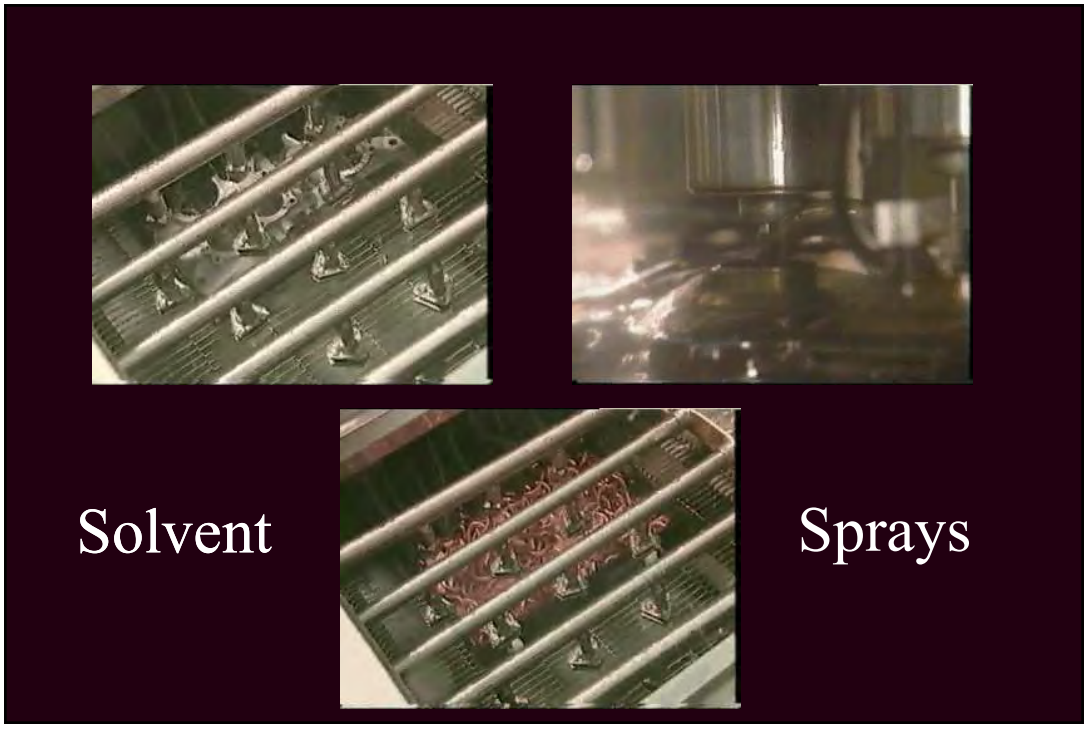
(pp 200-8)


OPEN TOP
DEGREASER
condensing coils
freeboard
water jacket
heating elements


TWO
COMPARTMENT
OPEN TOP
DEGREASER
offset solvent
boiling chamber
warm solvent
immersion chamber


DEGREASER


HOIST OPERATION
1. NEVER OPERATE THE HOIST WITHOUT REMOVING VAPOR DEGREASER LID
2. NEVER CHANGE BASKETS WHILE HOIST IS OPERATING
3. NEVER LIFT BASKET AND BASKET HOOK WHILE HOIST IS OPERATING
4. NEVER LOAD HOIST BASKET WITH PARTS LARGER THAN THE BASKET
CAUTIO
EYE PROTEC
REQUIRED
IN THIS AR


Solvent
Sprays

Open Top Vapor Cleaners

Important Elements:

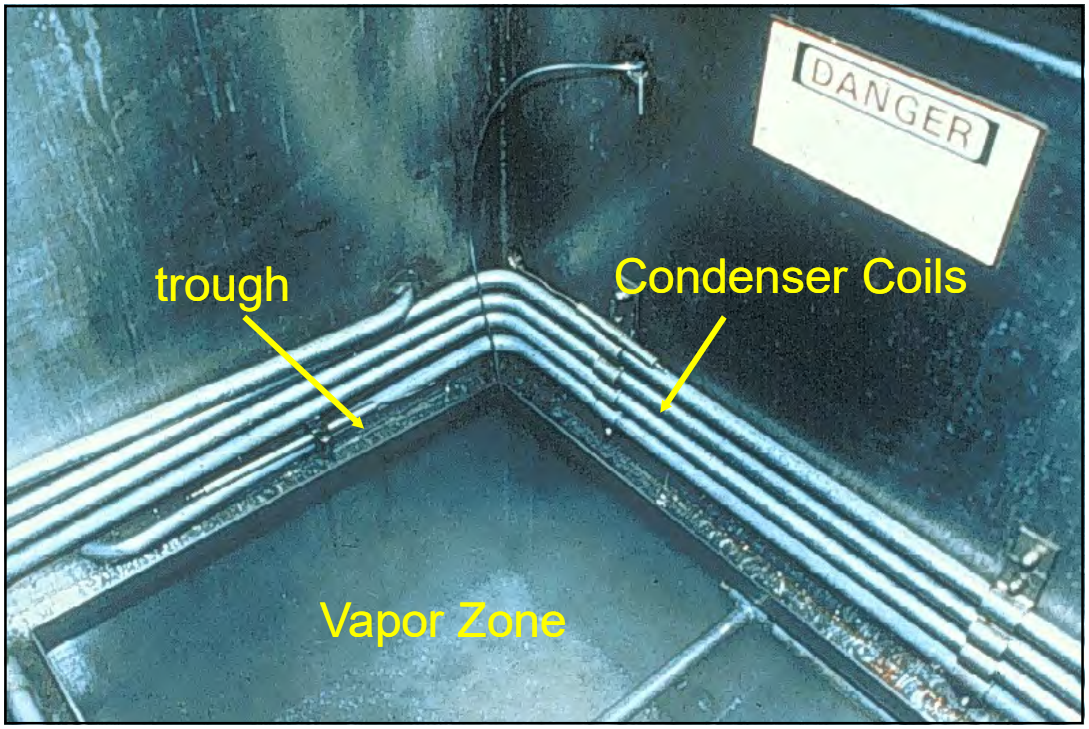
- Condenser Coils
- Freeboard
- Water Separators
- Covers

(pp 300-7-13)

Cooling Coils

- Located On Inside Walls Of Cleaner
- Contains Vapor Zone With Cool Air Blanket Cover
- Usually Has Water As The Coolant

(pp 300-7)


DANGER
trough
Condenser Coils
Vapor Zone

Freeboard

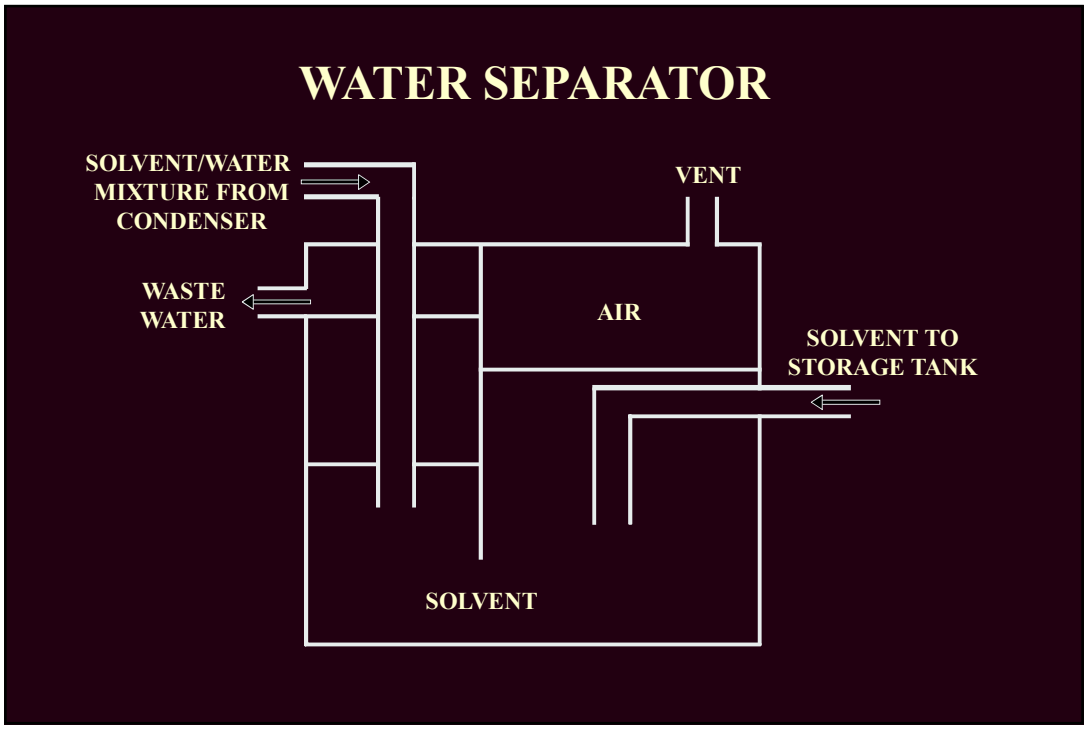
- Protects The Solvent Vapor Zone From Disturbance Caused By Air Movement Around The Equipment
- Generally Established By The Location Of The Condenser Coils

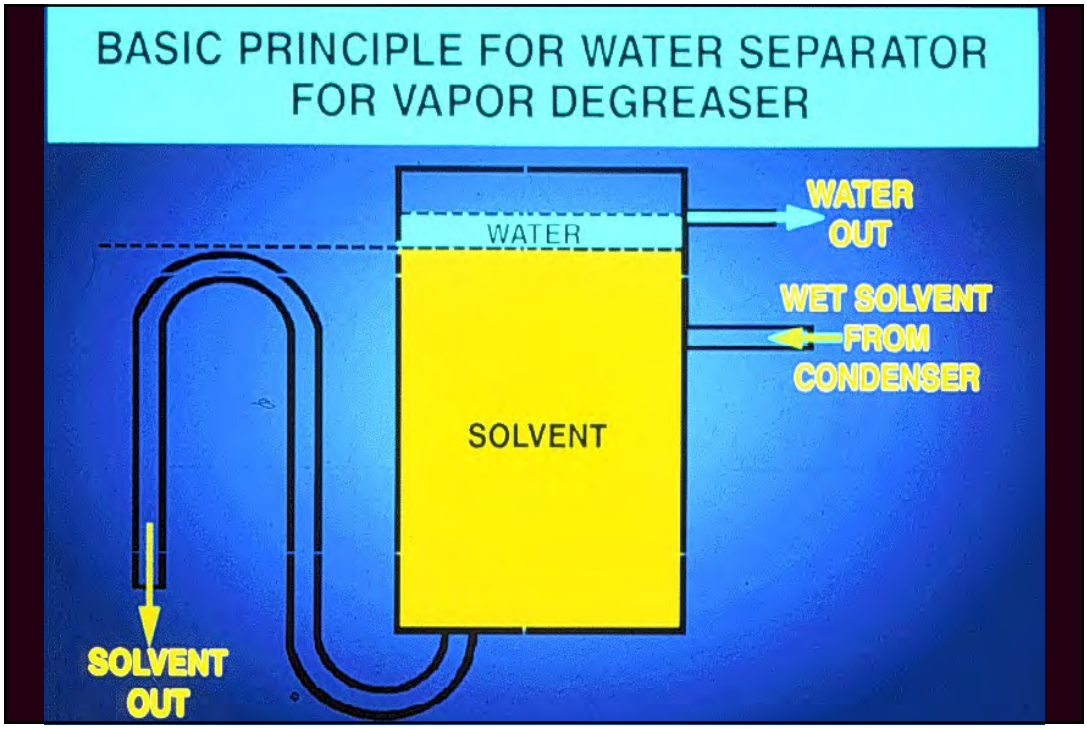
(pp 300-7)

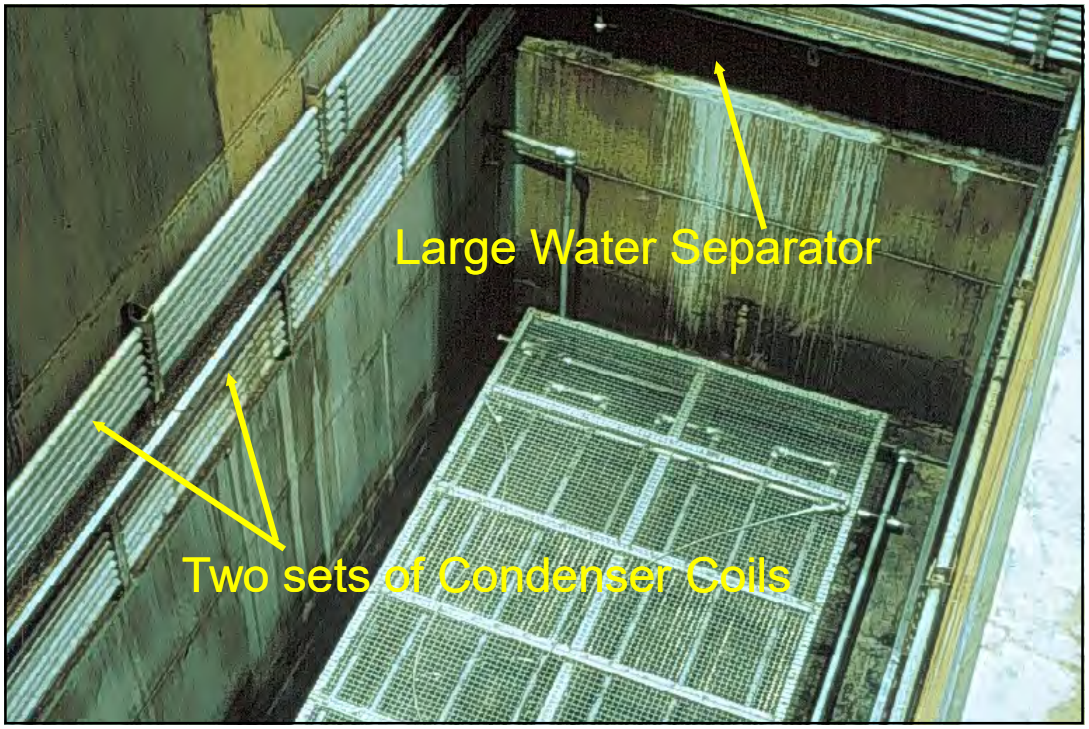
Water Separators

- Nearly All Vapor Cleaners Have Water Separators
- These Allow The Water That Condenses On The Coils To Separate From The Solvent Before The Solvent Is Reintroduced In The System

(pp 300-13)


WATER SEPARATOR
SOLVENT/WATER MIXTURE FROM CONDENSER
VENT
WASTE WATER
AIR
SOLVENT TO STORAGE TANK
SOLVENT

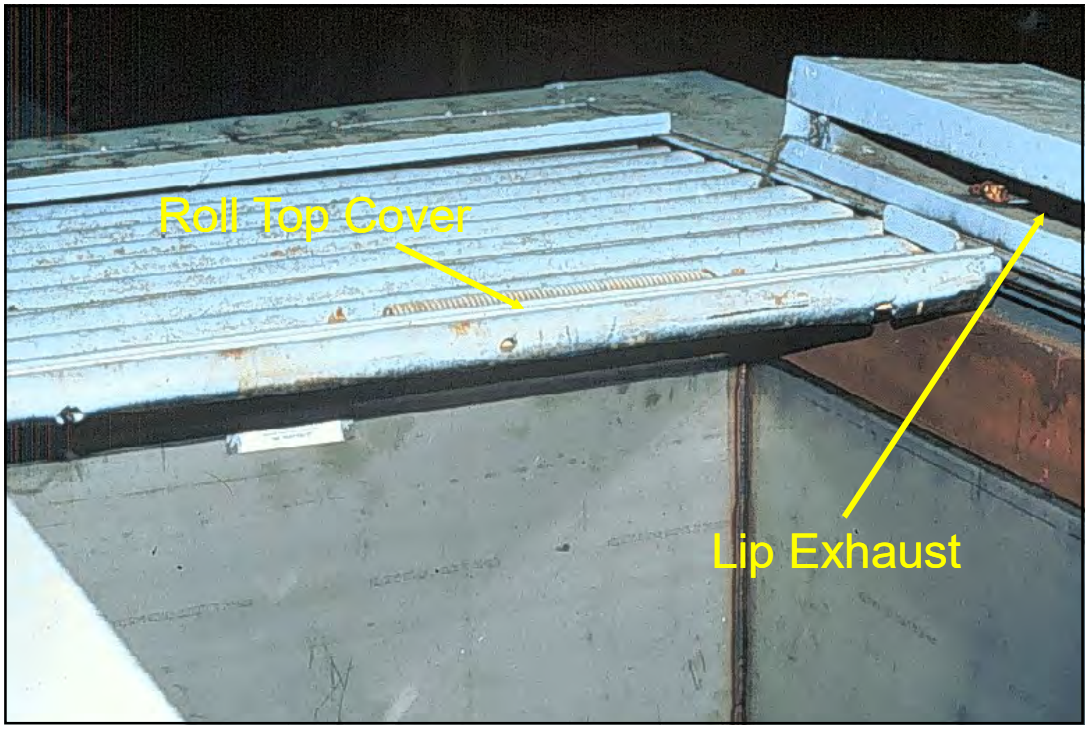

BASIC PRINCIPLE FOR WATER SEPARATOR
FOR VAPOR DEGREASER
WATER
WATER OUT
WET SOLVENT FROM CONDENSER
SOLVENT
SOLVENT OUT



Covers

- Historically Single Piece, Unhinged Metal Cover
- Newer Designs Might Have:
  - Roll-top Plastic Covers
  - Canvas Curtains
  - Hinged Counter Balanced Metal Covers

(pp 300-13)



Conveyorized Degreasers

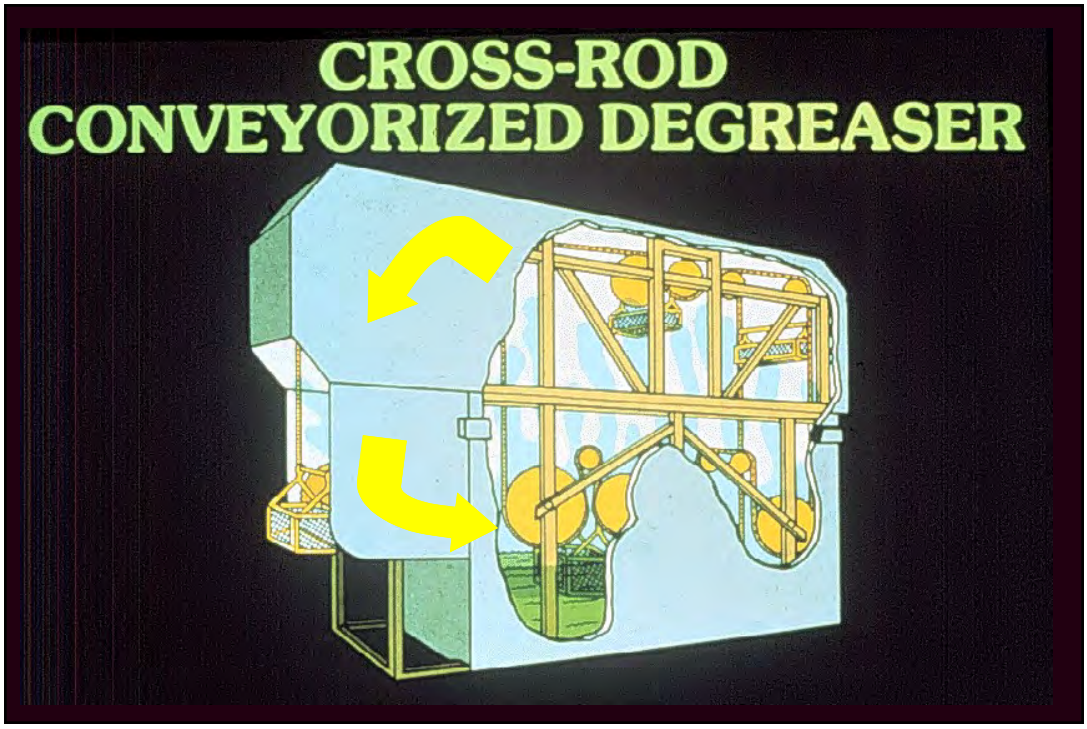
- Average Unit Emits About 25 Metric tpy.
- About 15% Of Nationwide total.
- There Are Seven Different Types:
  - Cross-Rod
  - Monorail
  - Vibra
  - Ferris Wheel
  - Belt
  - Strip
  - Circuit Board

(pp 300-14)

Cross-Rod Degreaser

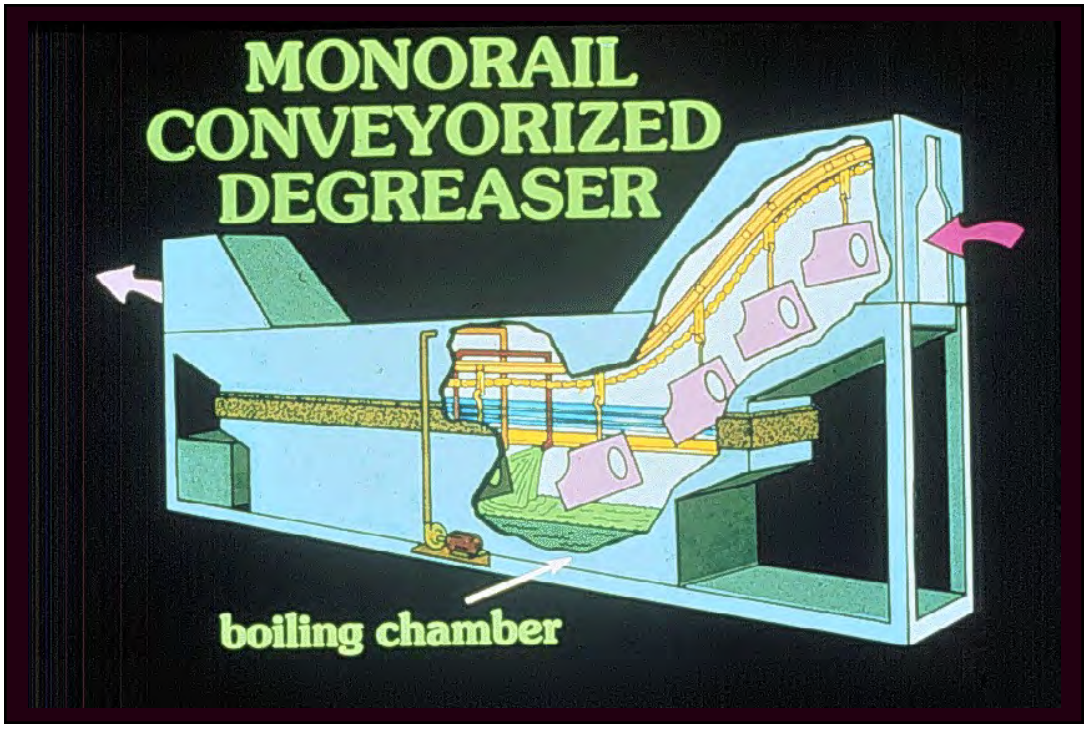
- Parts are supported by Rods Between The two Power Driven Chains.
- Designed To immerse Small Parts.

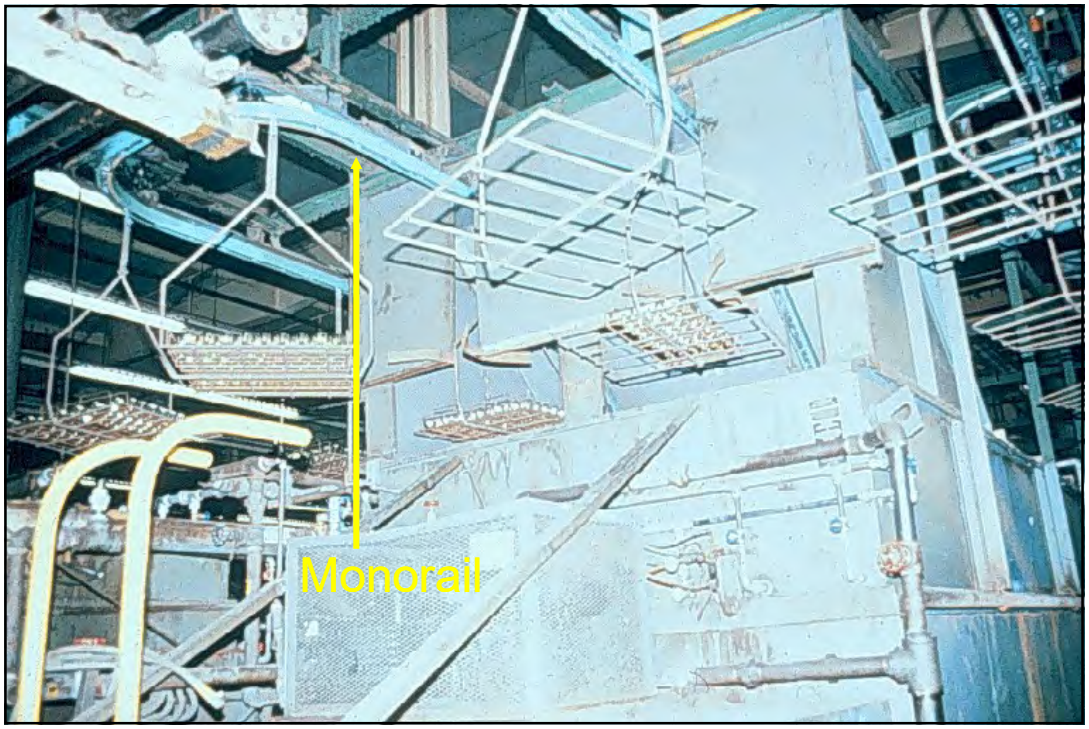
(pp 300-14)



Monorail Degreasers

- Used when The Parts To Be Cleaned Are Being Transported Between Manufacturing Operations.
- Automatic Cleaning With Solvent Spray And Vapor.

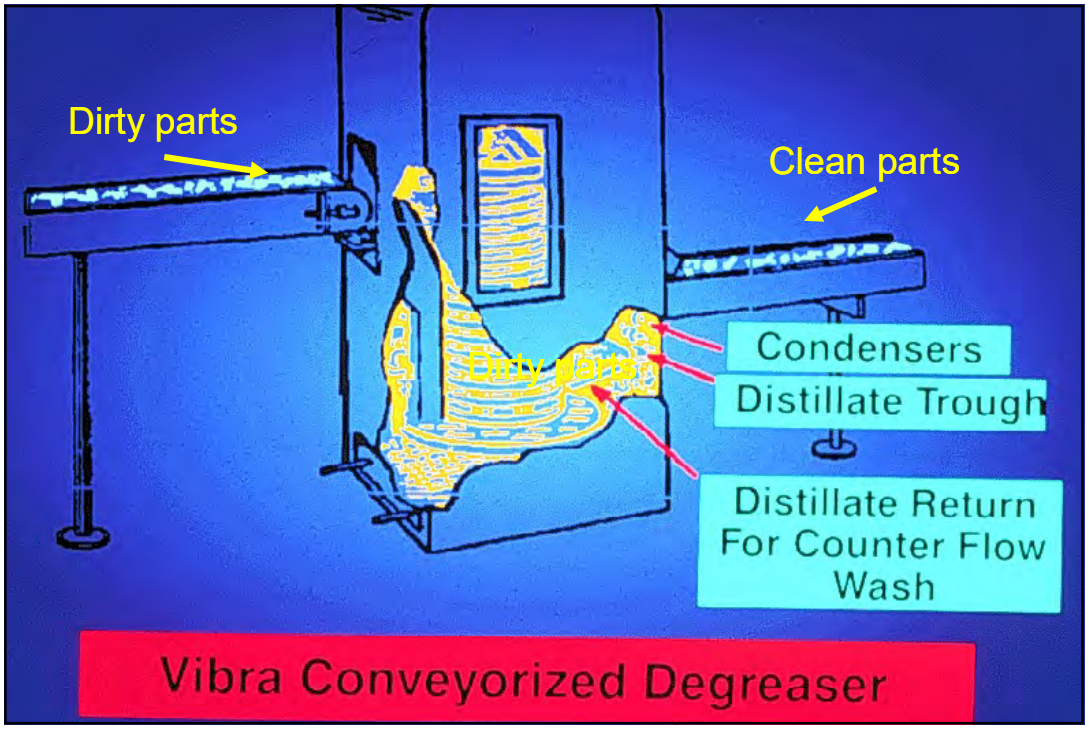




Vibra Degreaser

- Metal Parts Are Vibrated From A Solvent Flooded Pan Up A Spiral Elevator To Dry Before Exiting.
- Capable Of Processing Small Parts.
- Vibratory Action Creates Considerable Noise.

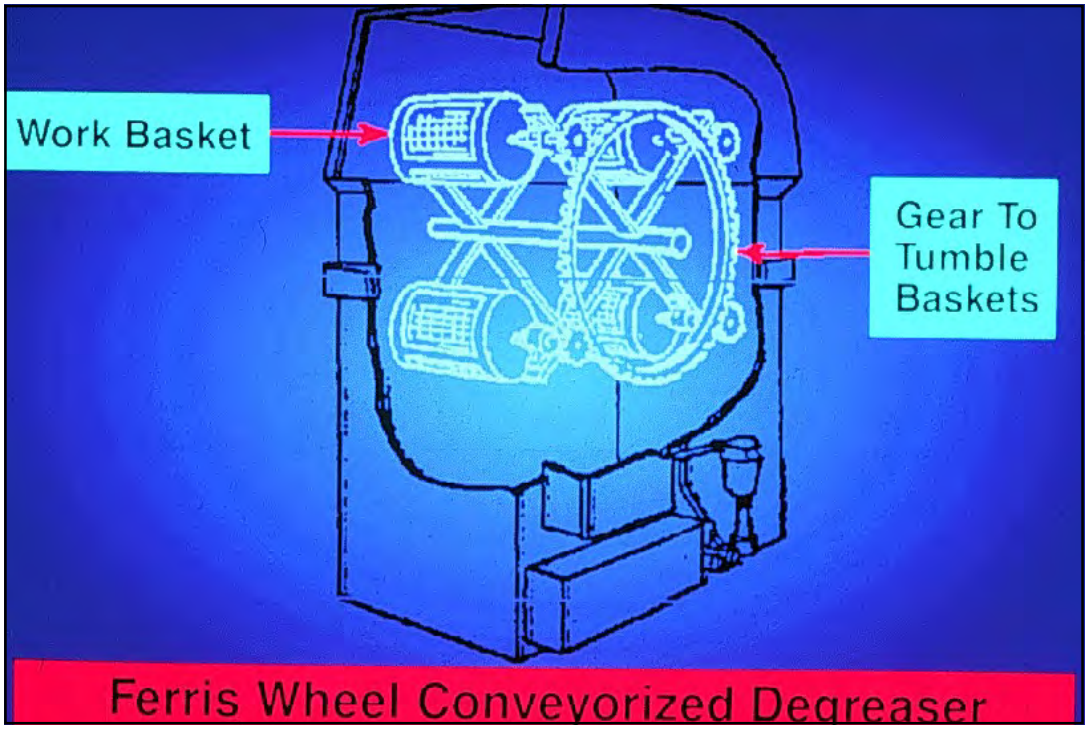
(pp 200-14)



Ferris Wheel Degreaser

- Least Expensive Conveyorized Degreaser
- Smallest.
- Uses Perforated Baskets

(pp 300-18)

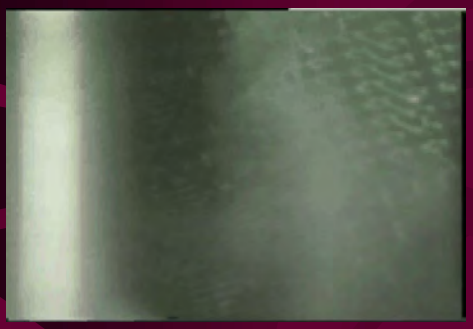

Work Basket
Gear To Tumble Baskets
Ferris Wheel Conveyorized Degreaser


OR FOOD ALLOWED
IN THIS AREA
Moving Basket

Belt & Strip Degreasers

- Enables Simple Loading And Unloading Of Parts.
- Strip Degreaser Also Cleans The Strip While A Belt Degreaser Does Not.

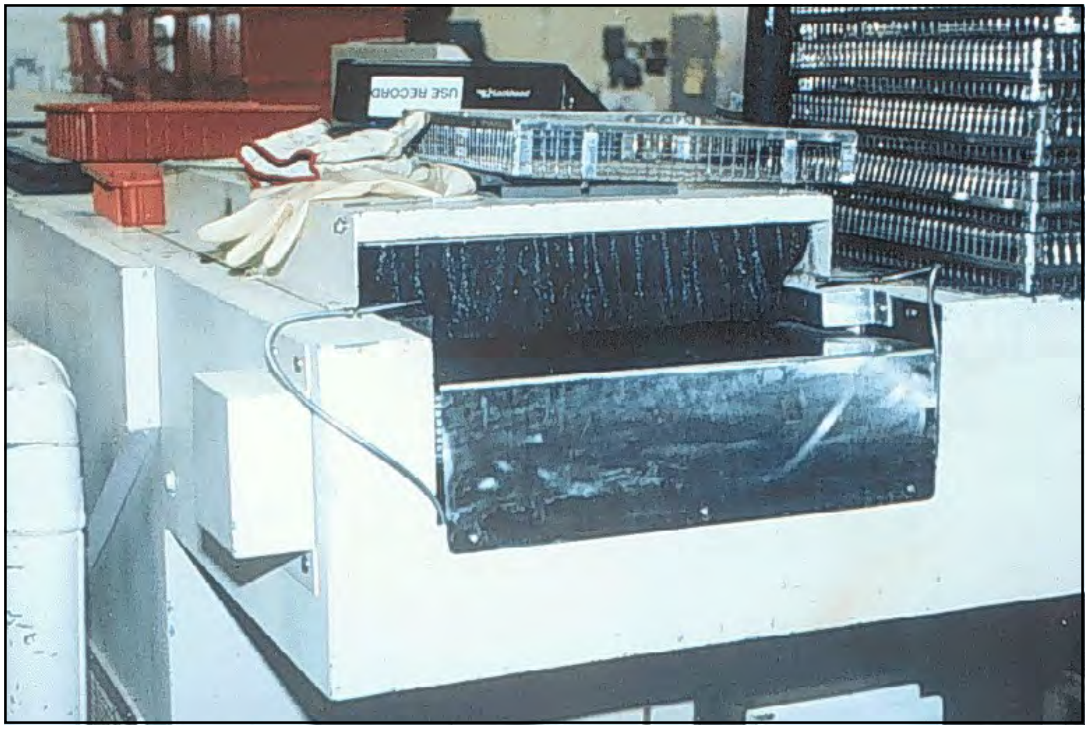
Circuit Board Cleaner



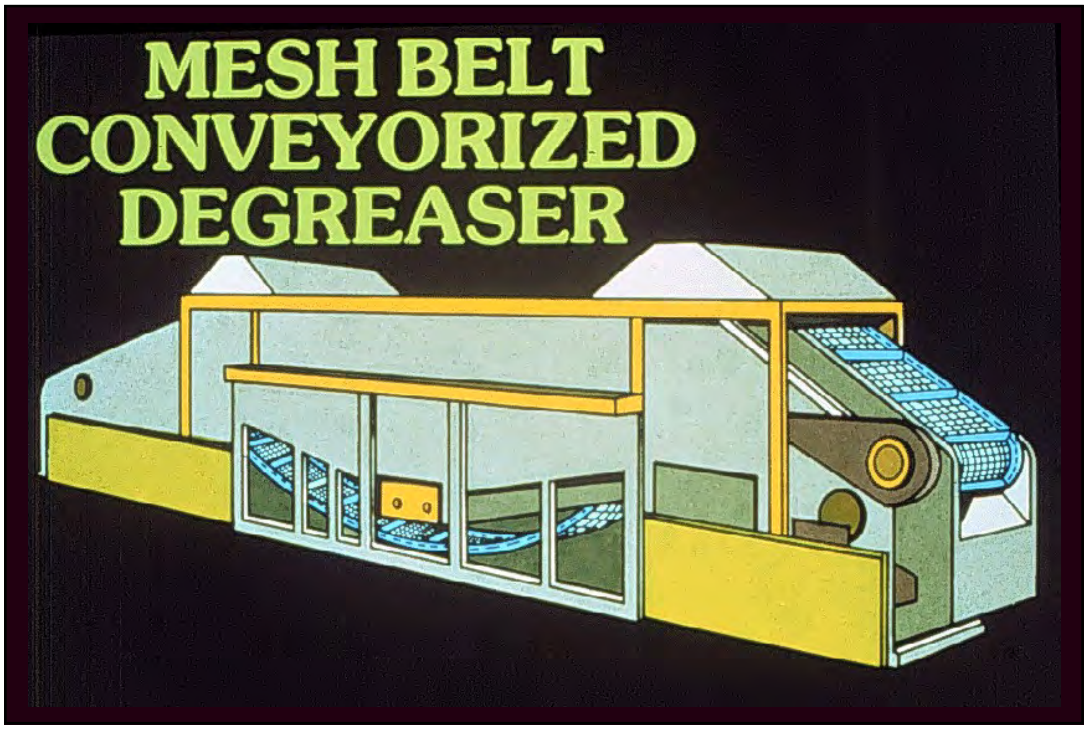
- Used Specifically In The Production Of Printed Circuit Boards.
- There Are Two Types:
  - Developers
  - Strippers

(pp 300-18)


Nozzle tips



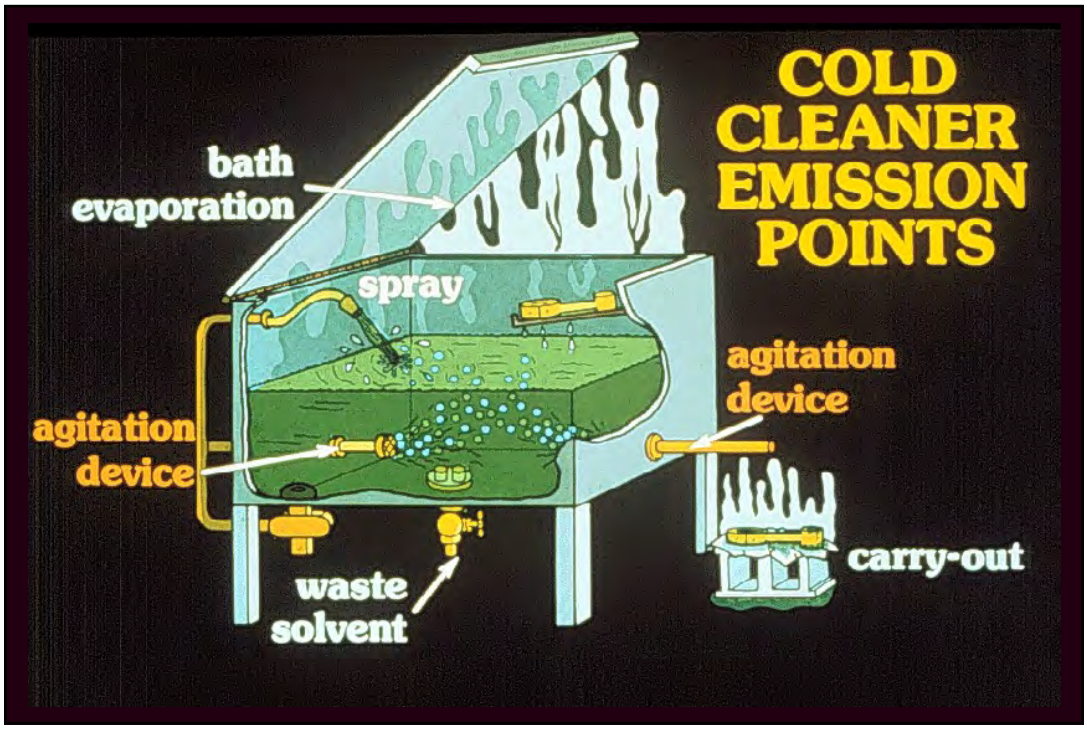

CORROSIVE
FLAMMABLE LIQUID
ATTENTION

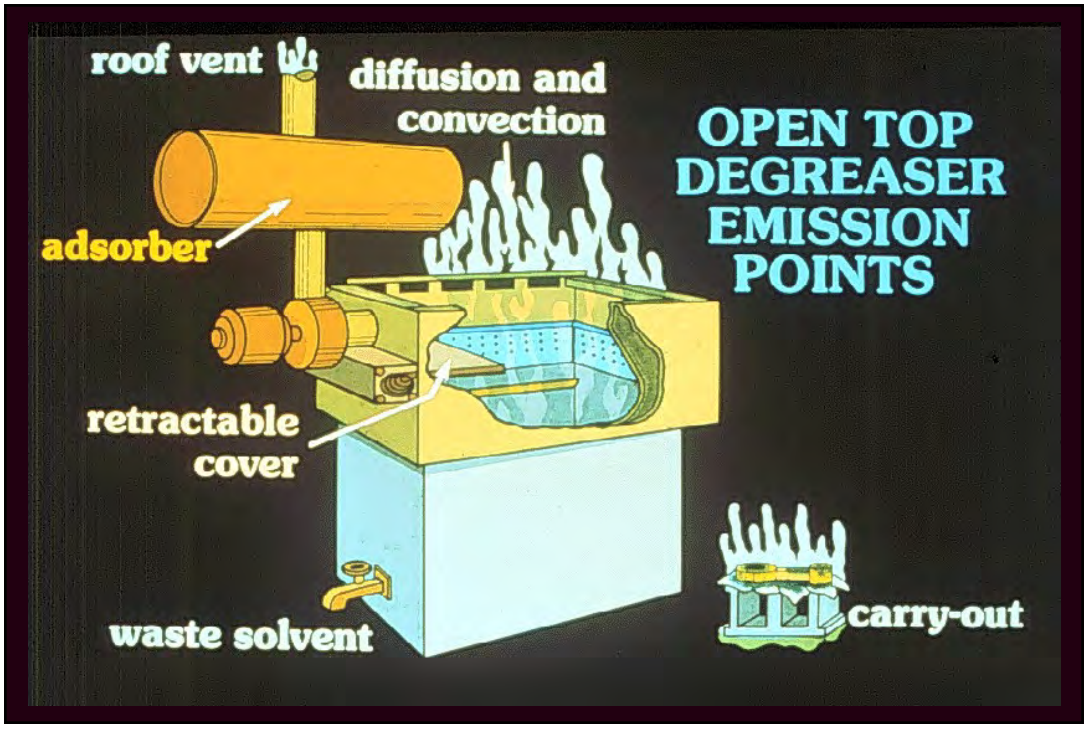

MESH BELT
CONVEYORIZED
DEGREASER

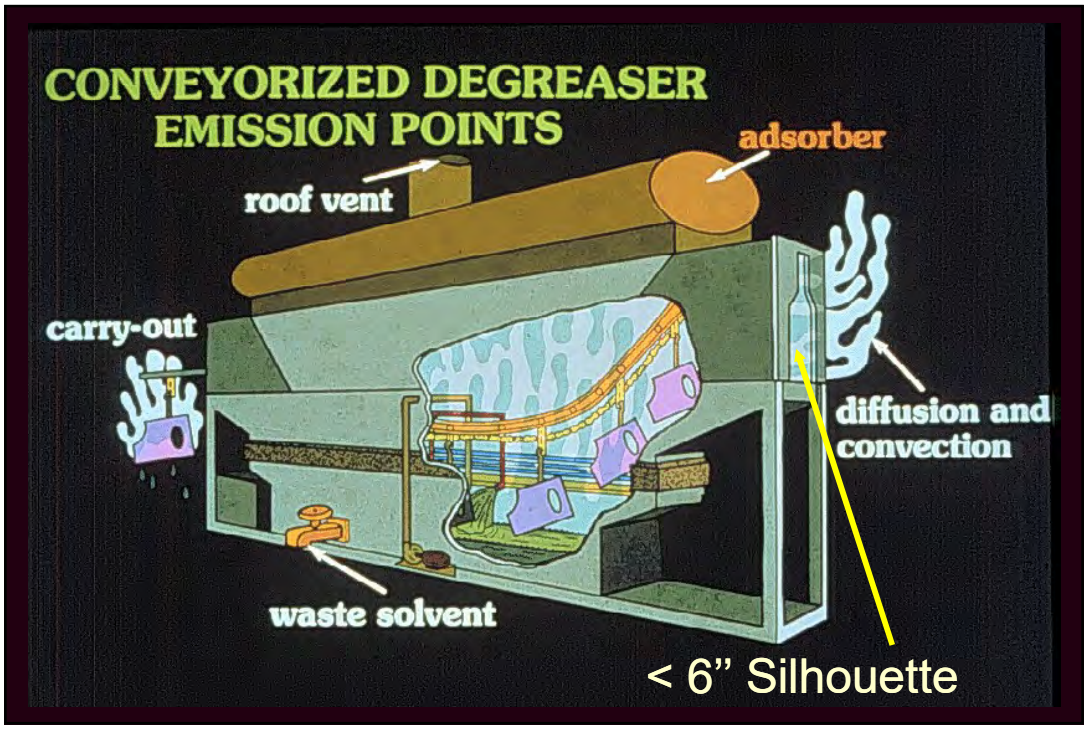

Conveyorized Circuit Board Cleaner


Mesh Belt Conveyorized
Circuit Board Cleaner
Silhouette Clearance
B


Emissions &
Emissions Control


COLD CLEANER EMISSION POINTS
bath evaporation
spray
agitation device
agitation device
carry-out
waste solvent


roof vent
diffusion and convection
OPEN TOP DEGREASER EMISSION POINTS
adsorber
retractable cover
carry-out
waste solvent



Emissions Of Concern

VOC ---> O_3

- VOC Emissions
- Toxic Emissions
- CFC Emissions

CFC ---> O_3

DANGER
TOXIC
VAPORS

(pp 300-18-19)

Control Technology

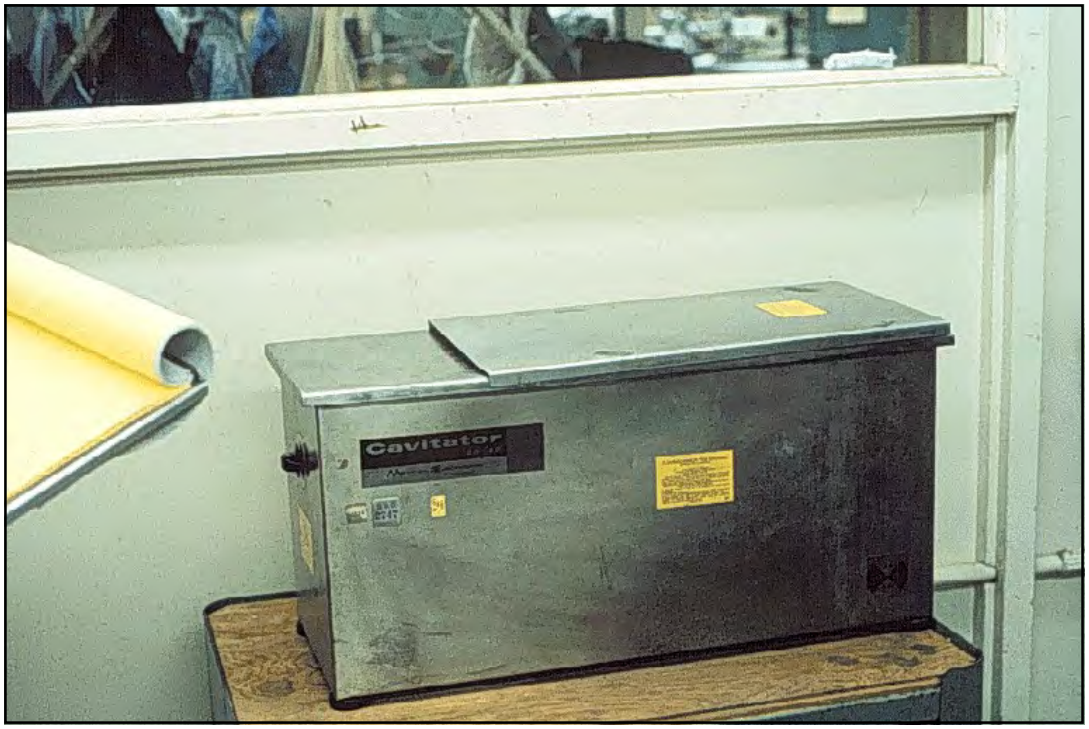
- Improved Cover
- High Freeboard
- Refrigerated Chillers
- Carbon Adsorption
- Safety Switches
- Thermal Reduction

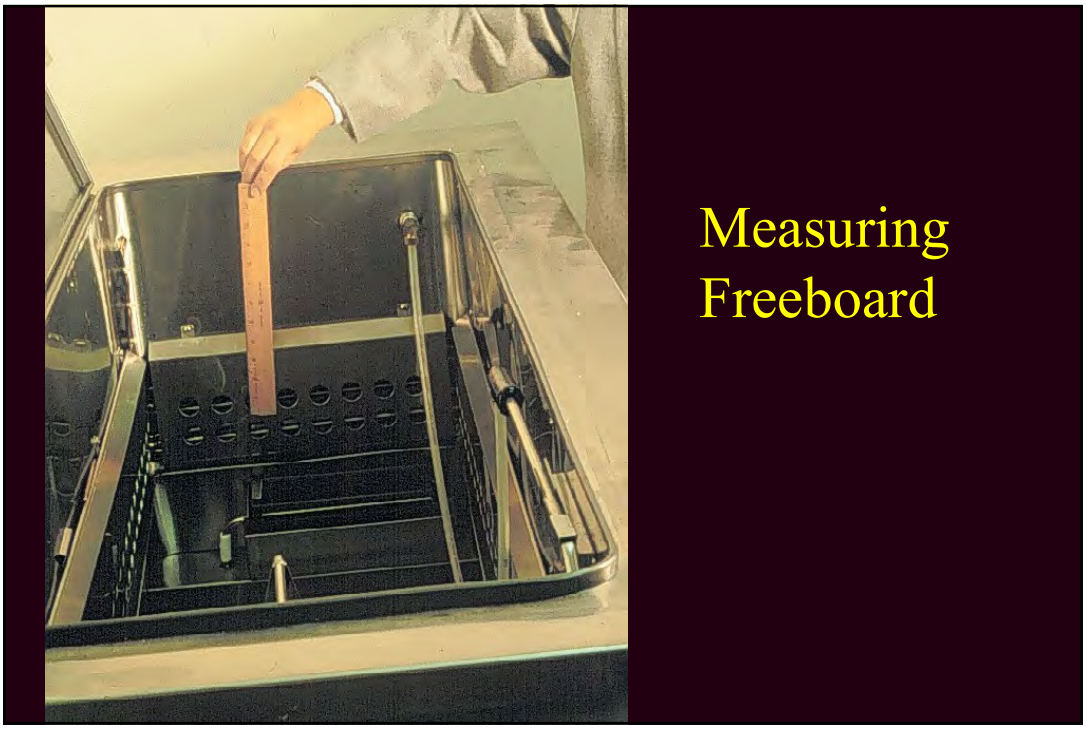
(pp 300-20)

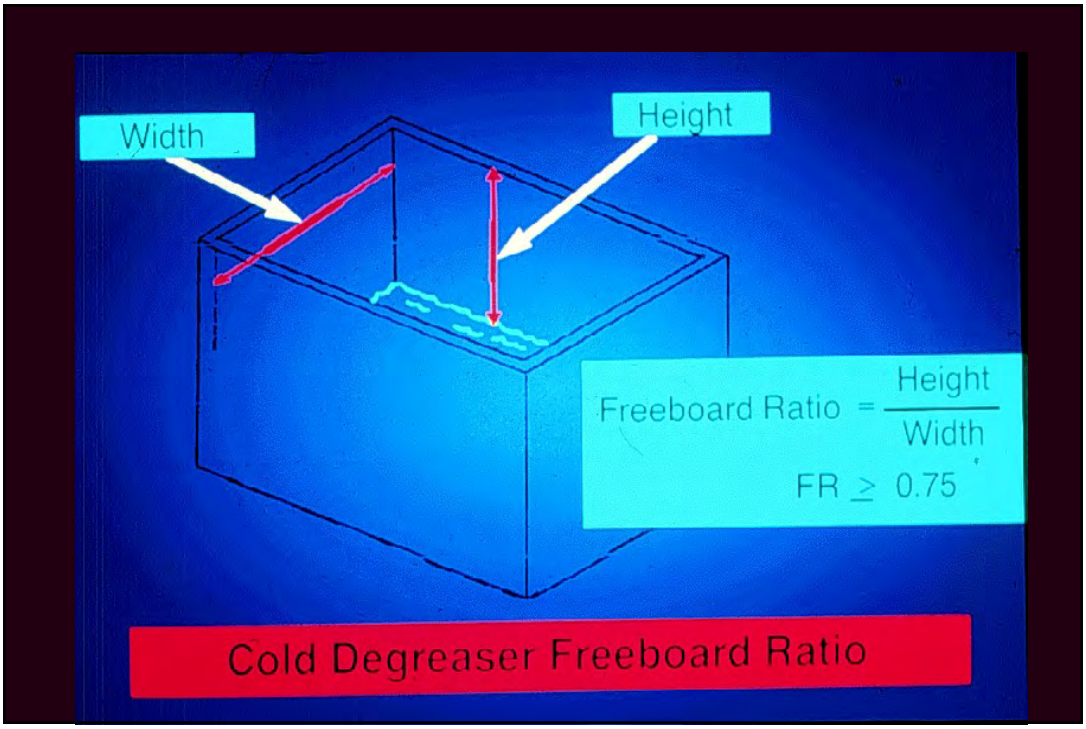
Improved Covers

- Single Most Important Control Device For Open Top Vapor Degreasers
- Open & Close In A Horizontal Direction
- Includes Plastic Covers, Canvas Curtains, And Guillotine Covers
- Also Includes Water Cover

(pp 300-20-22)

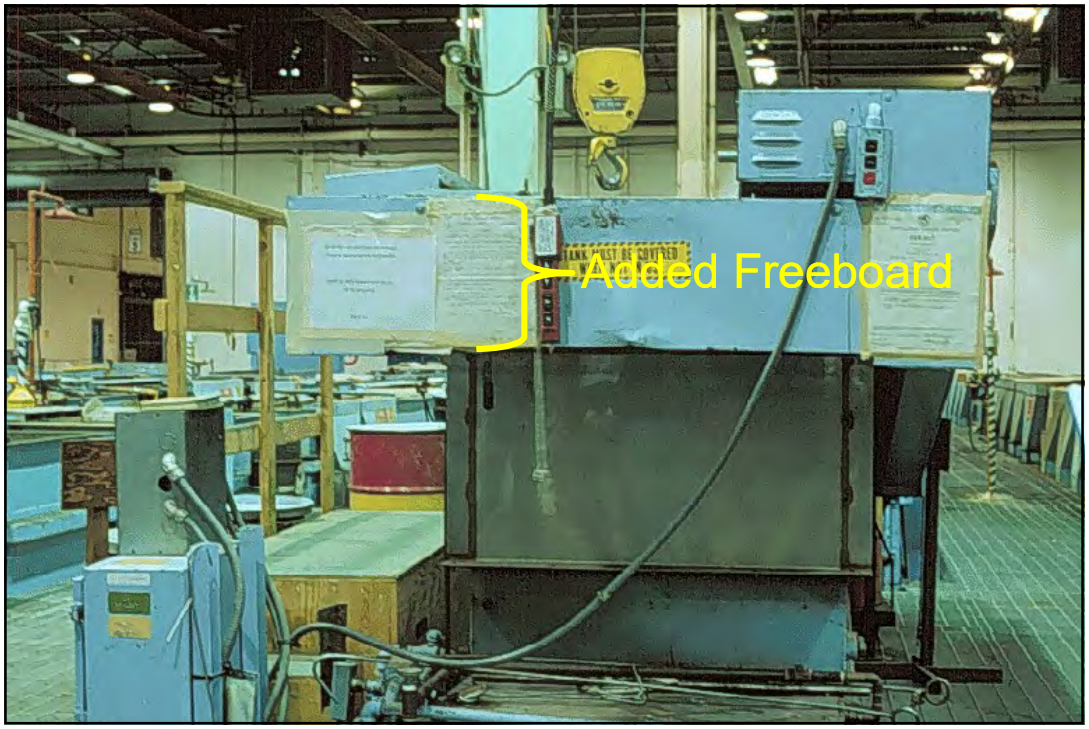

Cavitator


Measuring
Freeboard


Width
Height
Freeboard Ratio = Height / Width
FR ≥ 0.75
Cold Degreaser Freeboard Ratio

High Freeboard

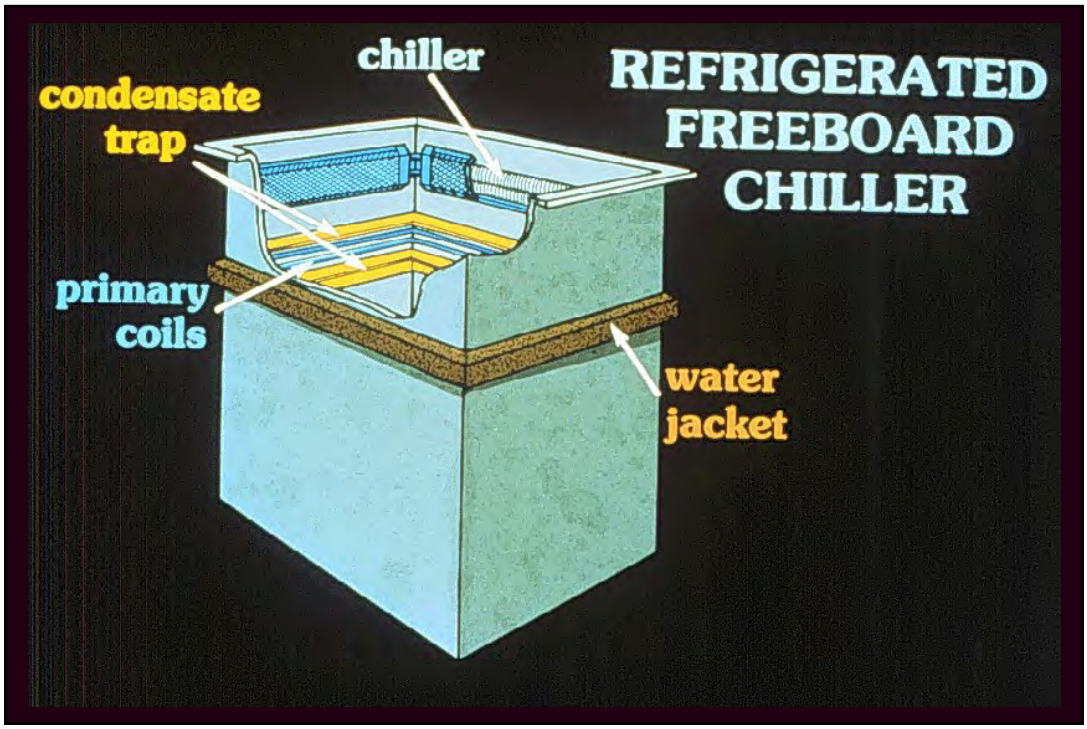
- Distance From The Top Of The Solvent To The Top Of The Tank Reduces Draft Near Air/Solvent interface
- Minimum Recommended Ratio = 0.75
- Ratio Of 1.0 - MACT For Halogenated Solvents
- OSHA Requires at Least 6" For Cold Cleaners



Refrigerated Chillers

- Condenser Coils
  - Create Cold Air Blanket
  - Results In A Temperature Gradient
  - Provides A Stable Inversion Layer
- Chillers
  - Offers More Cooling
- Refrigerated Condenser Coils
  - Offers Portability when not plumbed

(pp 200-23-25)

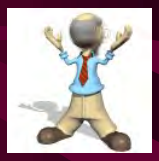

chiller
condensate
trap
REFRIGERATED
FREEBOARD
CHILLER
primary
coils
water
jacket

Adsorption

- Types Of Adsorbents:
  - Activated Carbon
  - Molecular Sieves
  - Silica Gels
- 90%+ Efficiency Possible
- Handles High VOC Concentrations
- High Humidity Decreases Efficiency
- VOC Mixtures Can Cause Problems

(pp 300-25 & 26)

Safety Switches



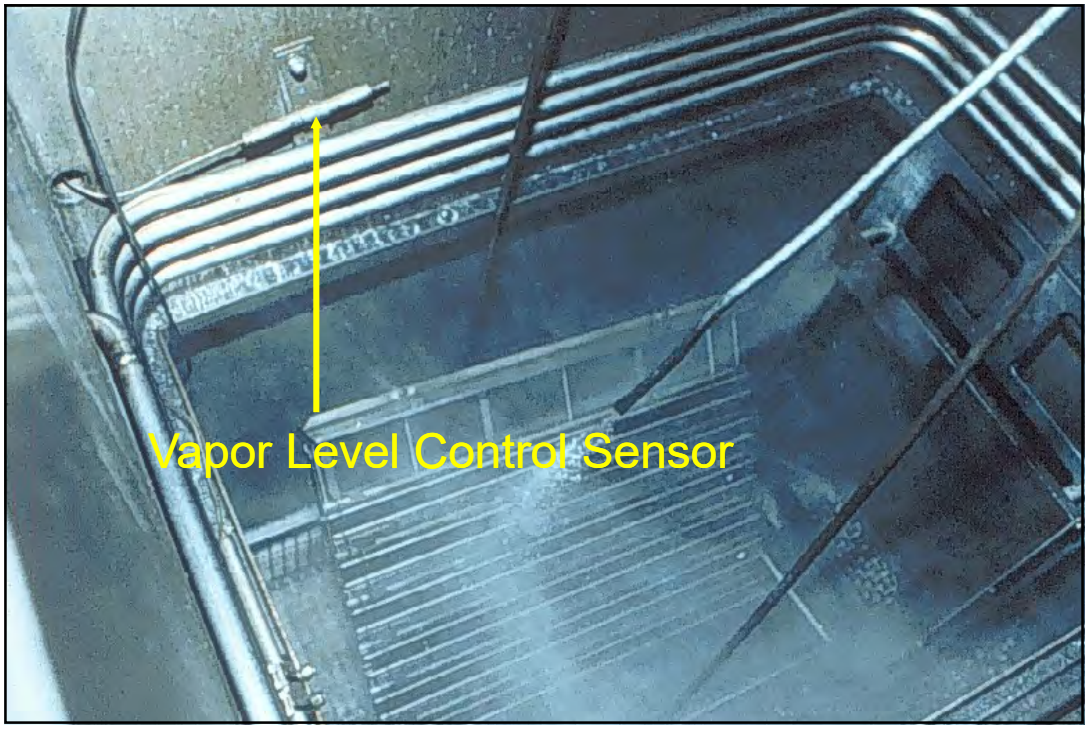
- Prevent Emissions During Malfunctions And Abnormal Operation
- Five Main Types:
  - Vapor Level Control Thermostat
  - Condenser Water Flow And Thermostat
  - Sump Thermostat
  - Solvent Level Control
  - Spray Safety Switch

(pp 300-27)

Vapor Level Control

- Most Important Switch
- Activated When Solvent Vapor Zone Rises Above The Designed Operating Level
- Turns Sump Heater Off
- For Conveyorized Degreasers, Should Activate an Alarm

(pp 300-27)



Condenser Water Flow

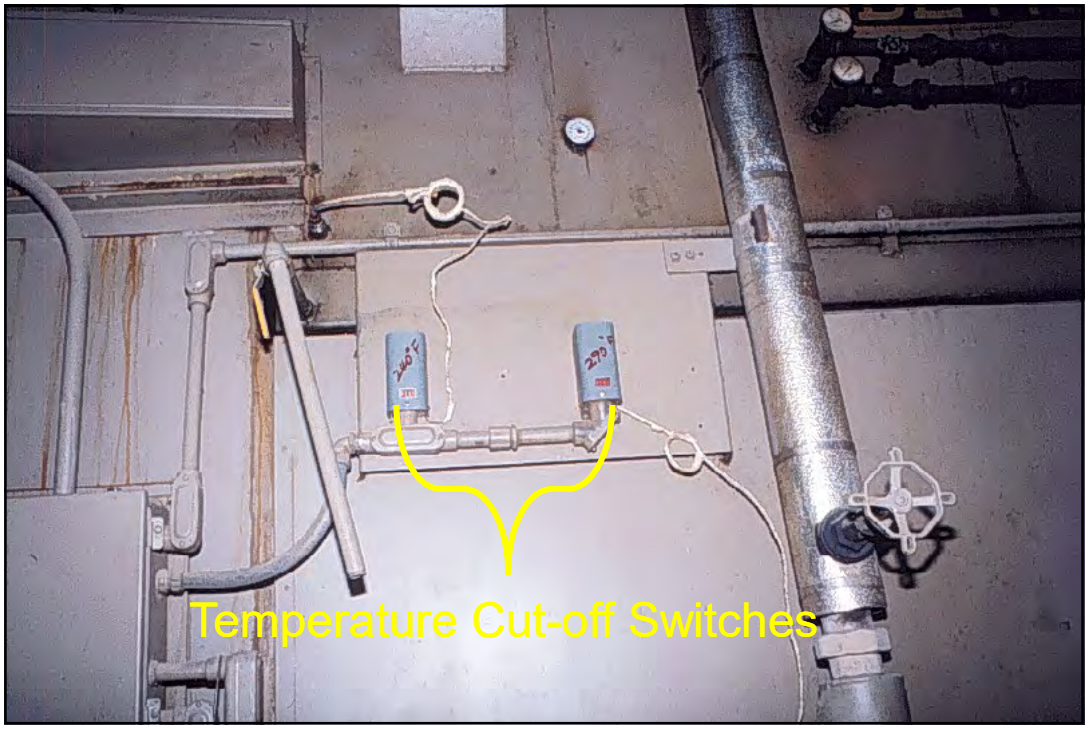
- Turns Off Sump Heat When:
  - The Condenser Water Stops Circulating
    Or
  - The Condenser Water Becomes Warmer Than Specified
- Serve As Back-up For The Safety Vapor Thermostat

(pp 300-28)

Temperature Cut-off Switch

- Cuts Off Heat When The Sump Temperature Rises Significantly Above The Solvents Boiling Point
- Prevents Decomposition Of Solvents
- Hydrochloric Acid May Be Formed If Solvent Level Becomes So Low It Touches Heating Element.

(pp 300-28)



Spray Safety Switch

- Deactivates The Pump Spray If The Vapor Level Drops Below A Specified Level
- Prevents Spraying Above The Vapor Level, Avoiding Excessive Emissions

Carry - Out Emissions

- Results When Clean Parts Still Containing Liquid Or Vapors Are Extracted From The Degreaser
- Main Control Device: Simple Drainage
- Other Controls include:
  - Drying Tunnels
  - Rotating Baskets

(pp 300-28 & 29)

Pre - Inspection

- Facility History (File Review)
  - How Many Permits?
  - Compliance Status - Pending Actions?
- Read Permit Conditions
  - Solvent Type
  - Solvent Usage Limits
  - Source Test Requirements?
- Inspection Forms
  - Fill Out As Much As Possible Prior To Inspection

(pp 400 - 1-3)

Inspection

- Introduce Yourself To Facility Manager
  - Explain the reason you are there
- Tell Manager Of Any Assistance you May need
- Verify Number & Type Of Degreasers Present
- Review Solvent Usage Records
- Inspect Each Degreaser in use, if possible

(pp 400 - 3-5)

Cold Cleaners

- Equipment Requirements
  - Check For Soundness (Leaks)
  - Check For Cover (when not in use)
  - Check For Changes In Freeboard
- Operational Requirements
  - Check Solvent Usage/Storage
  - Take Sample, If Necessary
  - Check Operation Parameters
  - Check Hoist Speed

(pp 400 - 6-8)

Vapor Degreasers

- Equipment Requirements
  - See Cold Degreaser Req.
  - Check Control Device If Present
  - Check All Safety Switches
- Operating Requirements
  - See Cold Degreaser Req.
  - Parts Degreased In Vapor Zone
  - Water In The Water Separator
  - Check Operation Of Lip Exhaust

(pp 400 - 8-9)

Conveyorized Degreasers

- Equipment Requirements
  - See Cold Degreaser Req.
  - Check To See That Hood Is Present
  - Look For Drying Tunnel, Rotating Basket, Or Tumbler
  - Check Silhouette
- Operational Requirements
  - See Cold Degreaser Req.

(pp 400 - 10)

Air Pollution Control Points Of An Inspection

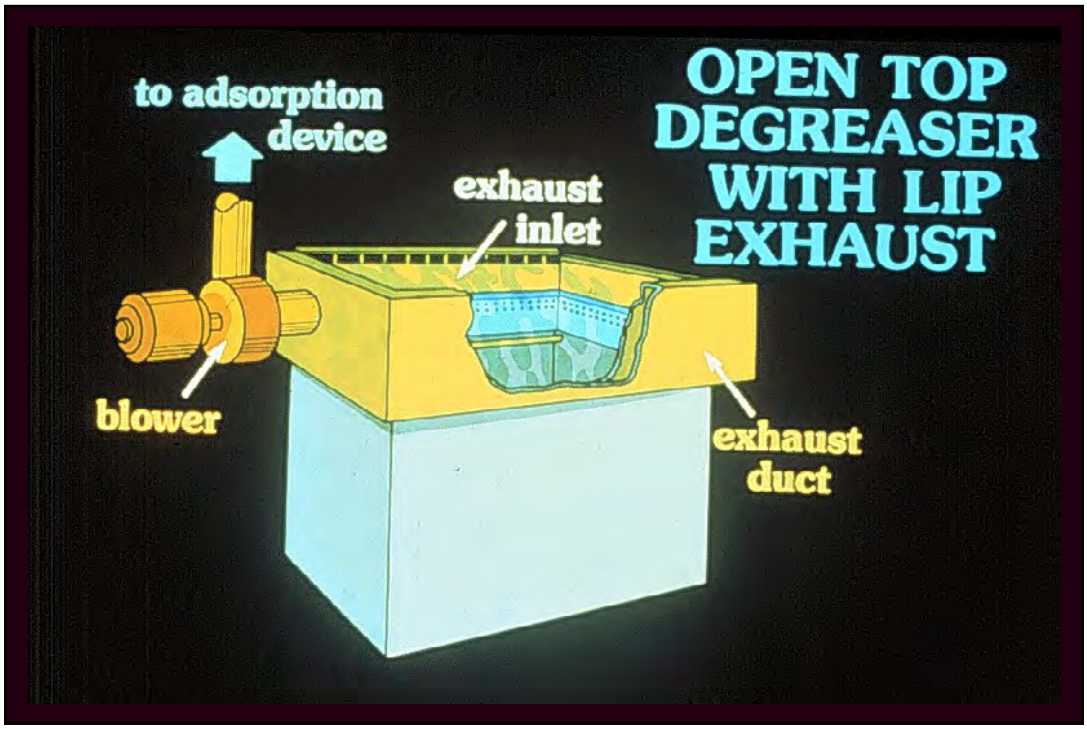
- Capture
- Transport
- Air Mover
- Instrumentation
- Control
- Subsystem

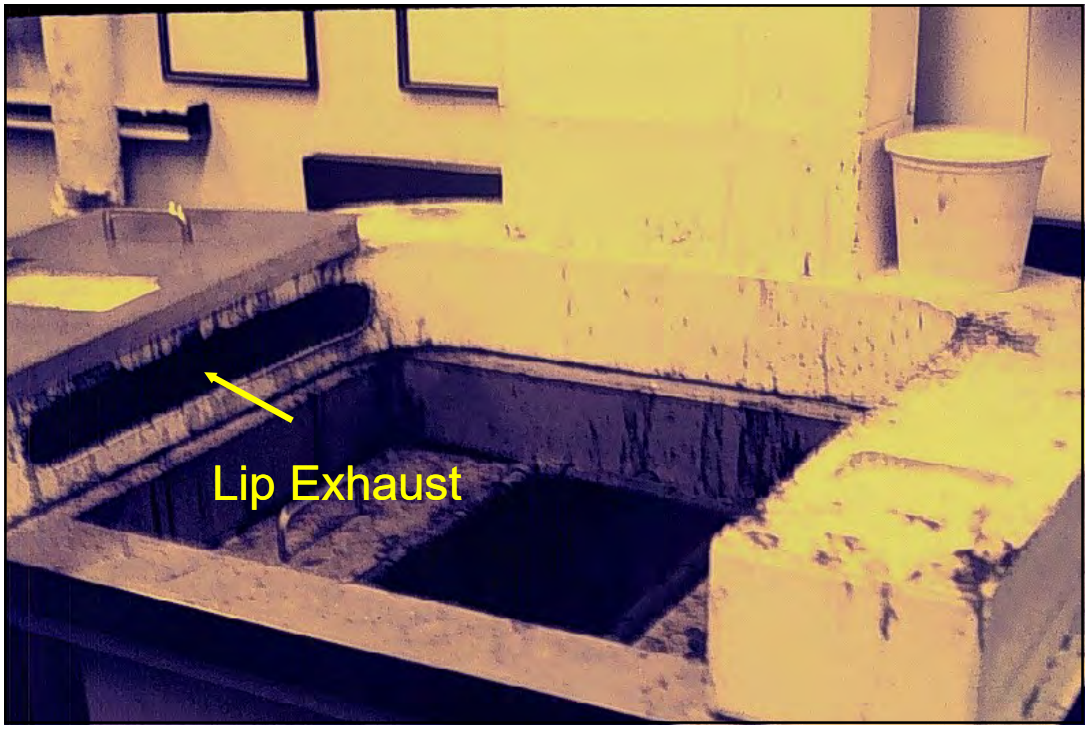
(pp 400-5)

Capture

- Are Process Emissions Drawn into A Control Device At The Point Of Release
- (Are They Drawn Into A Collection Device)
- If Lip Exhaust Is Installed, Is It On?

(pp 400-5)


OPEN TOP DEGREASER WITH LIP EXHAUST
to adsorption device
exhaust inlet
blower
exhaust duct


Lip Exhaust

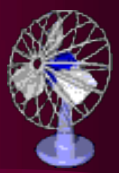
Transport

- Are Emissions Moved To The Control Device Without Loss
- Are There Any Leaks

(pp 400-5)

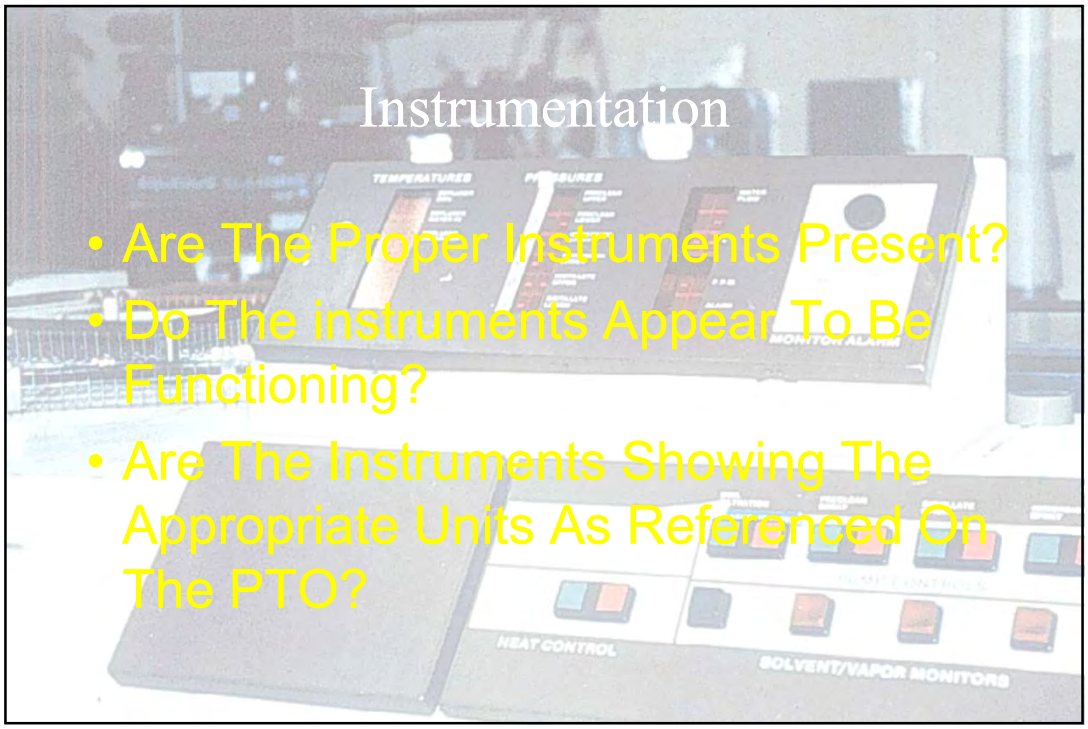
Ducting To Thermal Oxidizer On Roof

Air Mover

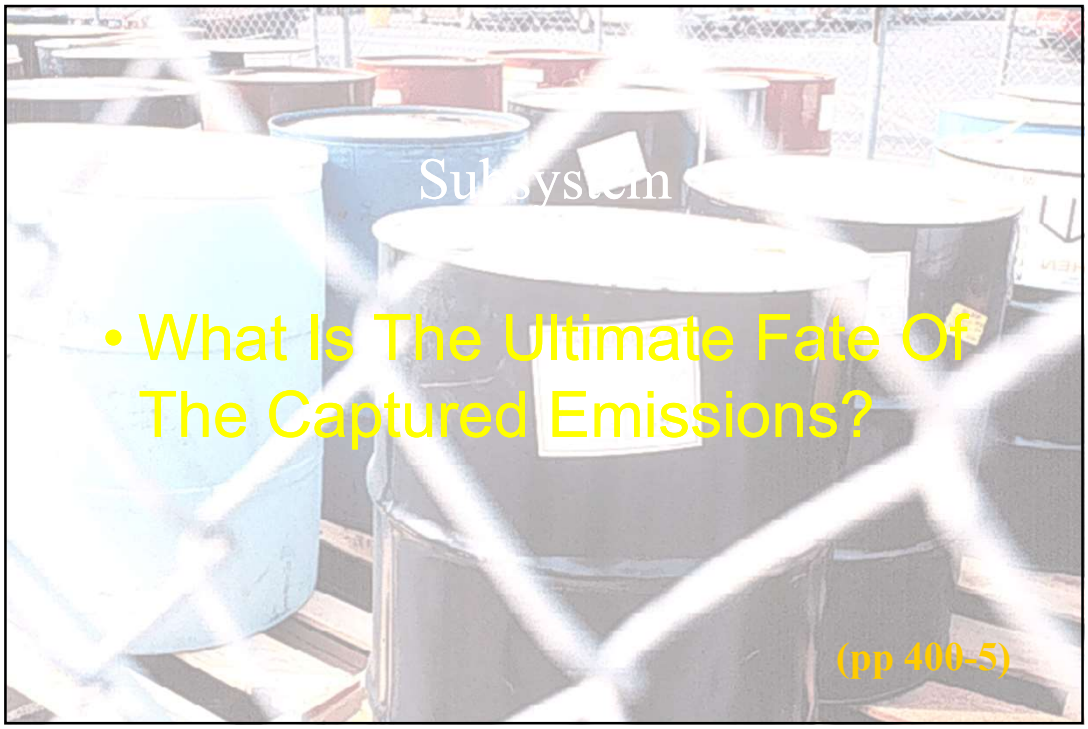


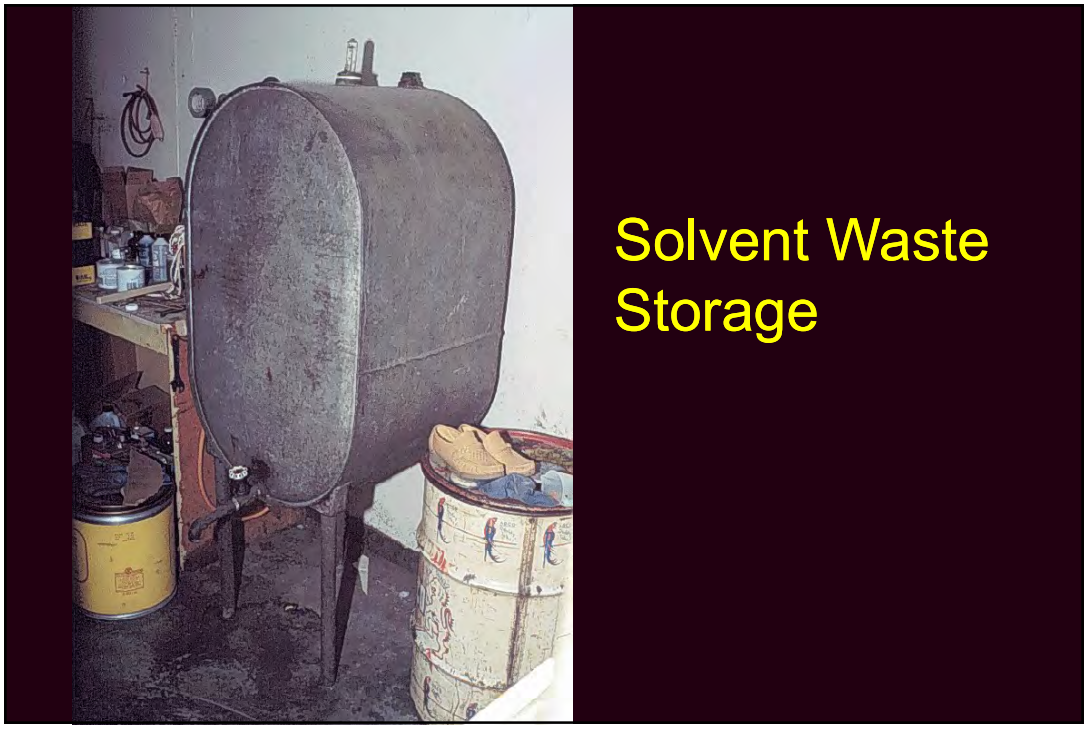
- Is The Fan Big Enough For The Job?
- Is It Operating As Designed And Permitted?

(pp 400-5)


Instrumentation
• Are The Proper Instruments Present?
• Do The instruments Appear To Be Functioning?
• Are The Instruments Showing The Appropriate Units As Referenced On The PTO?
TEMPERATURES
PRESSURES
HEAT CONTROL
SOLVENT/VAPOR MONITORS


Control Device
• Is It Functioning?
• Are There Any Visible Emissions?
(pp 400-5)


Subsystem
• What Is The Ultimate Fate Of The Captured Emissions?
(pp 400-5)

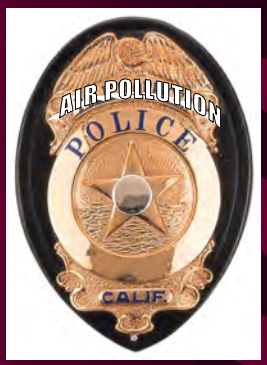

Solvent Waste Storage

What About Violations?

- Notice To Comply (NTC)
  - Minor Deficiency
  - Non-Emissions Related
  - Non-Recurring

What About Violations?

- Notice Of Violation (NOV)
  - Emissions Related
  - Same Problem As Last Inspection



Reason To Issue An NTC

- Incomplete Records
- Minor Equipment Change Without Notifying The AQMD
- Some Records Missing

(If Not Emissions Related)

Reason To Issue An NOV

- Exceeded Permitted Solvent Usage Limit
- Missing Or Incomplete Information Necessary To Determine Compliance
- Open Container
- Control Equipment Malfunction
- Failed Source Test
- Same Violation As Their Last Inspection

Four Options After An NOV

- Continue To Operate In Violation
- Cease The Noncompliant Activity
- Correct The Problem
- Apply For A Variance


L
Post - Inspection
Be Certain That You Have All The
Information To Determine Compliance
Before You Leave The Facility
• Explain Results To Facility Manager
• Follow-up On All Violations


Rule Discussion
• Exemptions
• Equipment Requirements
• Operating Requirements
• State BACT/RACT
• Federal NESHAPS/MACT
(Sec 500)

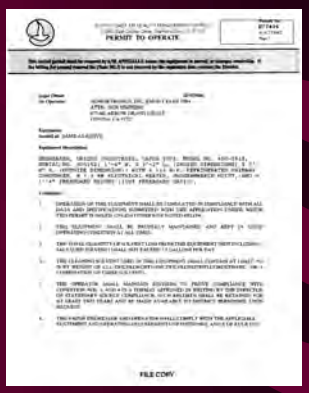
Exemptions

- Grandfather Exemptions
- Source Category Exemption
- Size Exemptions
- Equipment Exemptions
- Process Exemptions

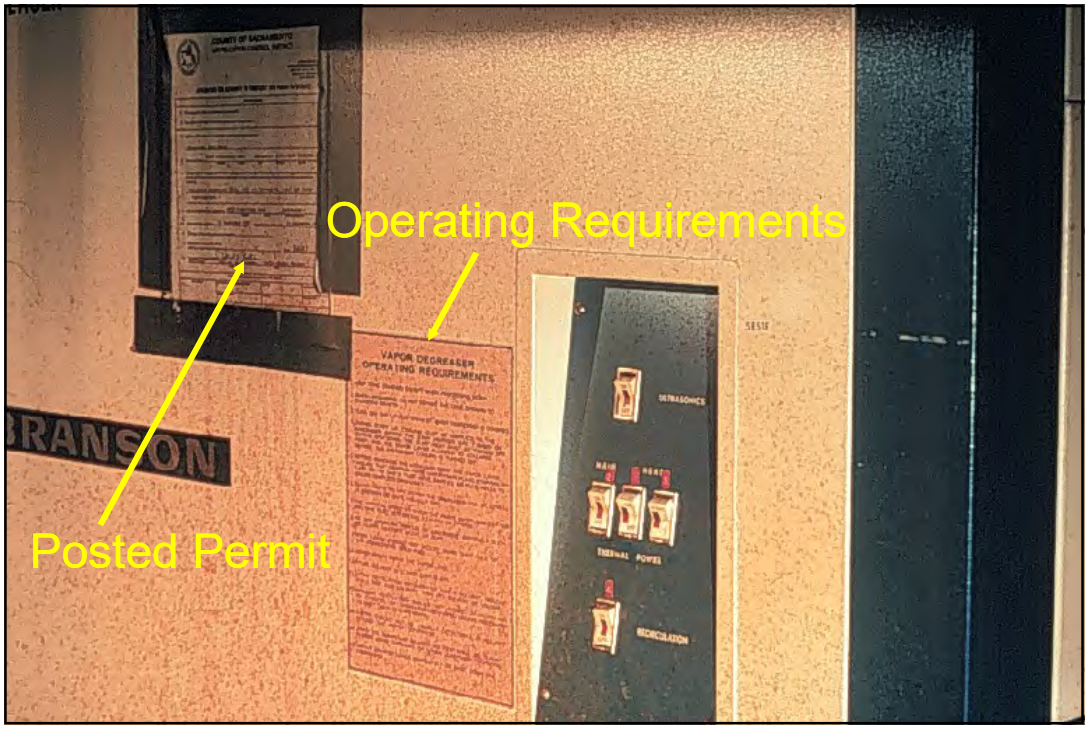
(Sec 500)

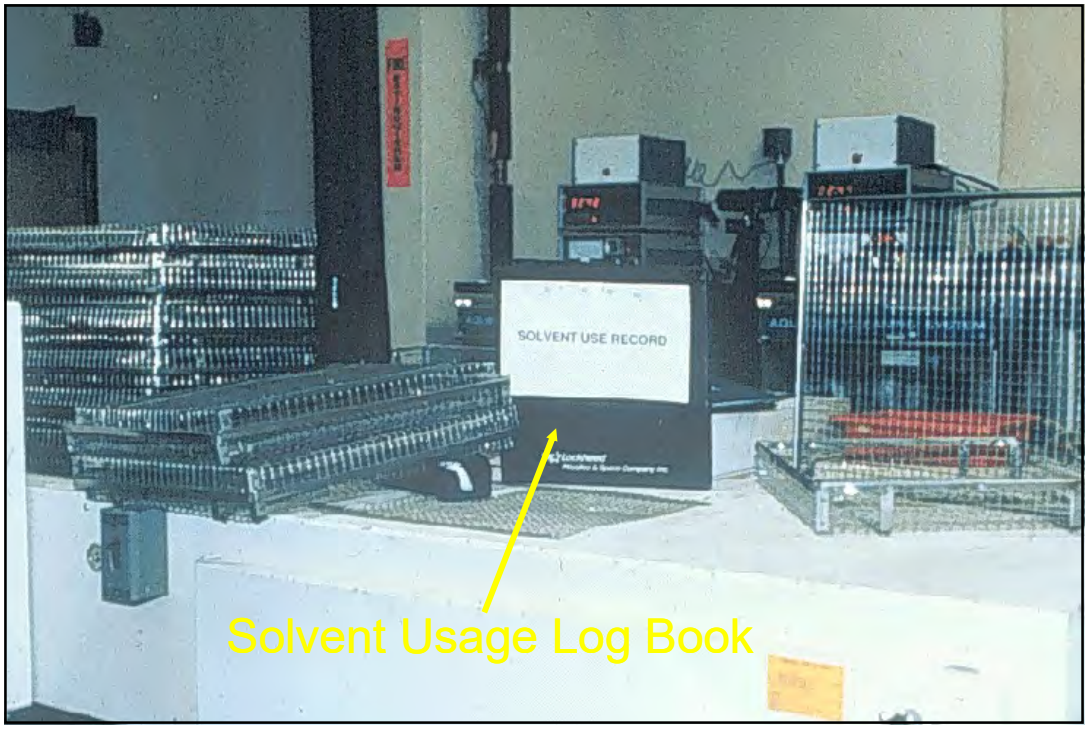
Authority To Construct And Permit To Operate

- Specified Conditions
- Maintenance Program
- Monitoring And Records
- Rule Limitations/Violations
- Records Reporting
- Maintenance Logs
- Manuals For O & M


PERMIT TO OPERATE

(pp 500-2 &3)


Operating Requirements
Posted Permit
VAPOR DEGREASER
OPERATING REQUIREMENTS
BRANSON
ULTRASONICS
THERMAL POWER
RECIRCULATION


SOLVENT USE RECORD
Solvent Usage Log Book

General Requirements

- Operating Conditions
- Solvent Agitation
- Porous Material
- Hoist Speed
- Parts Dry
- Lip Exhaust

(Sec 500)

Cold/Vapor Degreasers

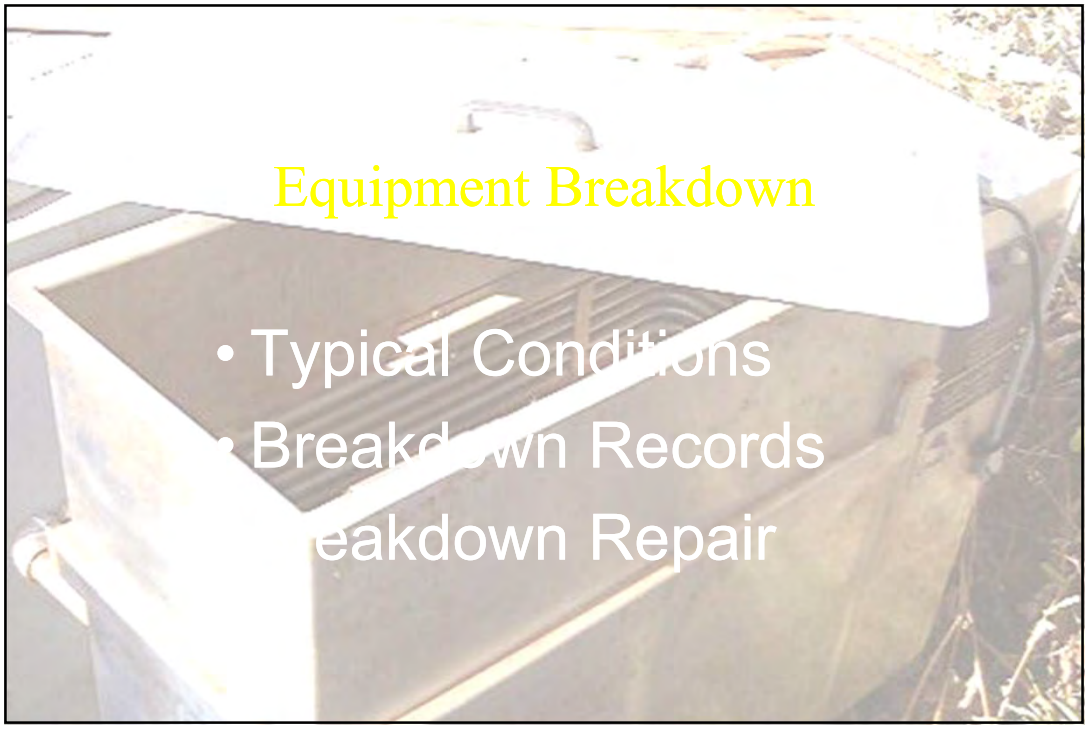
- Container
- Cover
- Drag Out/Drying Rack
- Control Equipment
  - Freeboard Ratio
  - Refrigerated Freeboard Chiller
  - Carbon Adsorption
  - Other Control Methods

(Sec 500)

Conveyorized Degreasers

- Hood
- Drying Tunnel
- Silhouetting

(Sec 500)



CALIFORNIA RACT/BARCT

- Covers All Types Of Cleaners
- Equipment Standards
- Operating Standards
- Prohibitions
- Exemptions

Federal NESHAPS/MACT For Halogenated Compounds

(40 CFR 63 Subpart T)

- Applicability
- Exemptions
- Standards
- Tests, Recordkeeping & Reporting

(Sec 500)

Halogenated Solvents, NESHAP Degreasing

Applicability

- Sources (regardless of annual emissions) using:
  - Batch Cold Cleaning Machines
  - Batch Vapor Cleaning Machines
  - In-line Vapor Cleaning Machines Using:
    - Methyl Chloride
    - Trichloroethylene
    - Carbon Tetrachloride
    - Perchloroethylene
    - 1,1,1-trichloroethane
    - Chloroform

Hal. Sol. NESHAP - Degreasing

Exemptions

- Total concentration of one or more of the six solvents must exceed five percent by weight for the rule to apply
- Does not apply to hand wiping
- Contains 2 gallons or Less

Hal. Sol. NESHAP - Degreasing

Standards - Batch cold Cleaners

- Must use a tightly fitting lid that is kept closed except when loading or unloading, and a one inch layer of water on solvent surface; or
- Must use a tightly fitting lid that is kept closed except when loading or unloading and have a freeboard ratio of > 0.75; or
- Remote reservoir machines must employ a tightly fitting lid over sump and lid must be kept closed except during parts cleaning

Hal. Sol. NESHAP - Degreasing

Standards - Batch cold Cleaners - work practices for control options 2 and 3

- **Collect & store waste solvent in closed containers;**
- **Flushing in freeboard area only;**
- **Drain cleaned parts for 15 seconds or until dripping stops, whichever is greater;**
- **Clean spills immediately;**
- **Store rags in covered container;**
- **Minimize solvent agitation to avoid splashing;**
- **Control room drafts when cover is open; and**
- **Cleaning of sponges, fabric, wood & paper products is prohibited.**

Hal. Sol. NESHAP - Degreasing

Tests, Recordkeeping & Reporting
Batch Cold Cleaning - One Time

- Initial compliance report stating required covers are free of holes, cracks or other emission impacting defects.

Hal. Sol. NESHAP - Degreasing

Standards - Batch Vapor & In-line Vapor Cleaners
Option 1 & 2 equipment design requirements

- Idling and downtime cover, or reduced room draft
- Freeboard ratio ≥ 0.75
- Automated parts handling with velocity ≤ 11 ft/Min
- Device to shut off sump heater if vapor level rises above primary condenser
- If lip exhaust is used, collected vapors must be routed to a carbon adsorber.

Hal. Sol. NESHAP - Degreasing

Standards - Batch Vapor & In-line Vapor Cleaners
Work practice standards

- Maintain equipment as recommended by manufacturer
- Minimize air disturbances in the machine room
- Minimize air disturbances due to parts movement
- Minimize solvent loss due to spraying operations
- Reduce pooling of solvent on and in parts
- Follow proper startup and shutdown procedures
- Follow proper solvent transfer procedures
- Store waste solvent in a closed container
- Do not clean absorbent materials
- Be prepared to take and pass an operator test.

Hal. Sol. NESHAP - Degreasing

Standards - Batch Vapor Cleaners with Air/Solvent Interface of $\leq$ 13 ft^2 - Acceptable Control Options

0.045 lbs/hr ft2 of solvent - air interface area or

- Working mode cover and freeboard ratio of 1.0 and superheated vapor
- Super heated vapor and freeboard refrigeration
- Working mode cover and freeboard refrigeration
- Refrigerated freeboard and reduced room draft
- Freeboard ratio of 1.0 and refrigerated freeboard
- Refrigerated freeboard and dwell
- Freeboard ratio of 1.0 and reduced room draft and dwell
- Refrigerated freeboard and carbon adsorber
- Freeboard ratio of 1.0 and super heated vapor and carbon adsorber

Hal. Sol. NESHAP - Degreasing

Standards - In Line Vapor Cleaners
Acceptable Control Options

0.021 lbs/hr ft2 of solvent - air interface area or

- If installed before August 29, 1995
  - Freeboard ratio of 1.0 and superheated vapor
  - Freeboard ratio of 1.0 and freeboard refrigeration
  - Freeboard refrigeration and dwell
  - Carbon adsorber and dwell
- If installed after August 29, 1995
  - Super heated vapor and refrigerated freeboard
  - Freeboard refrigeration and carbon adsorber
  - Super heated vapor and carbon adsorber.

Hal. Sol. NESHAP - Degreasing

Tests, Recordkeeping & Reporting

Batch Cold Cleaning

- Log of new solvents and discontinued solvents
- Calculations showing three month average monthly emission of less than 30.7 lbs per ft^2 per month

Hal. Sol. NESHAP - Degreasing

Tests, Recordkeeping & Reporting

In Line Cleaning

- Log of new solvents and discontinued solvents
- Calculations showing three month average monthly emission of less than
  - If installed before August 29, 1995
    - 31.4 lbs per ft^2 per month
  - If installed after August 29, 1995
    - 20 lbs per ft^2 per month