

# CARB 287 - Dry Cleaning

## NACT 287 – Dry Cleaning



California Air Resources Board  
National Training Program

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## History of DC Solvents

- Petroleum Solvents
  - 140°F Solvent
  - Stoddard
  - DF 2000
- TCE & Carbon Tet
- PERC
- TCA, CFC-113, HCFC's
- New Solvents

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## Physical Properties

Solvent	Molecular Weight	Boiling Point (F)	Flash Point (F)	Latent Heat of Vaporization	Kauri-butanol Value
PERC	165.8	250	***	90	92
Stoddard	140-150	310	103	118	28-45
CFC 113	187.5	118	***	63	31
1-1-1, Trich.	***	165	***	104	124
DF-2000	140	***	147	***	27

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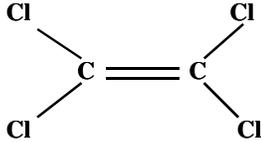
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# CARB 287 - Dry Cleaning

## PERC Properties

- Physical
- Chemical



Tetrachloroethylene

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**Material Safety Data Sheet**  **EXAMPLE**

Large Spills: Contain, isolate, and clean up. Do not allow the spill to spread. Do not use high pressure water to clean up. Do not use high pressure water to clean up. Do not use high pressure water to clean up.

**7. HANDLING AND STORAGE**

Storage: Store in a cool, dry, well-ventilated area. Store away from sources of heat or ignition. Do not store near foodstuffs. Keep containers closed at all times. Check regularly for leaks. Containers should be kept upright and secured. Do not use damaged containers or pipes. Bulk storage should be located in a well-ventilated area. Do not use high pressure water to clean up. Do not use high pressure water to clean up.

**8. EXPOSURE CONTROLS / PERSONAL PROTECTION**

National occupational exposure limits

TLV	STEL	Specific Gravity	Index
1000	1500	1.47	1.0

Exposure Standard (TLV) is the time-weighted average airborne concentration over an eight-hour working day for a 40-hour work week or an equivalent 16-hour working day. According to current knowledge this concentration should not be exceeded under normal conditions of use.

STEL Short Term Exposure Limit - the average airborne concentration over a 15-minute period which should not be exceeded at any time during a normal 8-hour workday.

Carcinogen Category 3 - substance suspected of being carcinogenic potential. The available information is not adequate for making a satisfactory assessment.

Health hazard information on gases, vapors and dusts of atmospheric health hazard. An atmospheric concentration should be kept as low as is feasible. These Exposure Standards should not be used as the basis for determining the relative and/or absolute concentrations of substances. They are not a measure of relative toxicity.

Engineering measures: Ensure ventilation is adequate to maintain concentrations below Exposure Standards. Use with local exhaust ventilation or with working organic vapor respirator or air supplied mask. Vaporize from hot or heated concentrations. Higher vapors. Do not use high pressure water to clean up. Do not use high pressure water to clean up. Do not use high pressure water to clean up.

Product name: PERCLEAN Version: 1.1 Substance No.: 0500101002  
Revised: 01-12-1997 Page: 2 of 7

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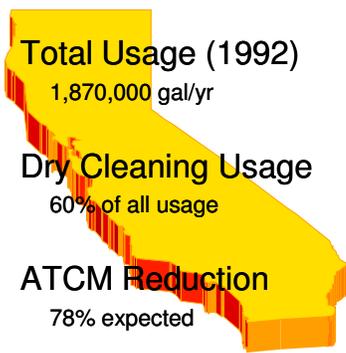
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## PERC Usage In California




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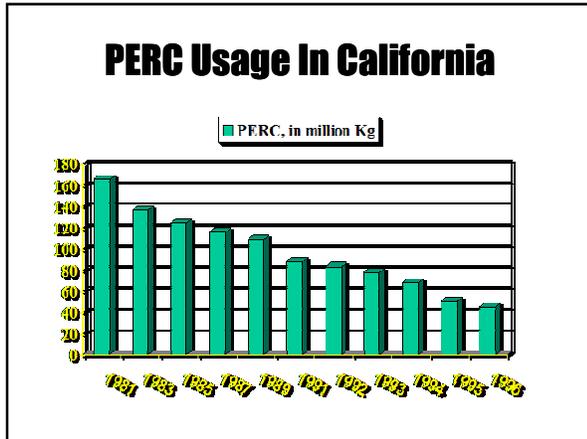
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# CARB 287 - Dry Cleaning



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### Health Effects of PERC

- Perc is a HAP
- Chronic & Acute Exposure
- Health Risks From Dry Cleaning

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### What is a TAC?

“An air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness” HSC 39655 (a)

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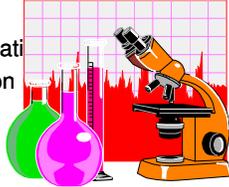
# CARB 287 - Dry Cleaning

## Air Toxics Program History

- PERC Identified Through A Formal Public Process in 1993

- OEHHA Evaluation
- ARB Evaluation

- HAP Listing



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## PERC Exposure Thresholds

Type of Limit	(ppm)
State OSHA PEL	25
Federal OSHA PEL	100
Federal OSHA Ceiling	200
State OSHA Ceiling	300
Federal OSHA Peak	"

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## Potential Health Effects From PERC Dry Cleaning

- Health Risks
- Individual Cancer Risk
- Non-Cancer Risk
- Non-Cancer Health Effects



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# CARB 287 - Dry Cleaning

## The Dry Cleaning Process

- Wash Cycle
- Extraction Cycle
- Drying Cycle
- Cool Down Cycle



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## Dry Cleaning Equipment and Operations

- Types Of Dry Cleaning Machines
- Machine Requirements Of MACT
- Major Dry Cleaning Components
- Primary, Secondary, and Fugitive Controls

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## Equipment Evolution

- Machine Generations:
  - 1<sup>st</sup> - Transfer Machines
  - 2<sup>nd</sup> - Dry-To-Dry Vented
  - 3<sup>rd</sup> - Dry-To-Dry Nonvented
  - 4<sup>th</sup> - Refrigerated and Carbon Adsorber
  - 5<sup>th</sup> - Secondary Control w/Drum Monitor



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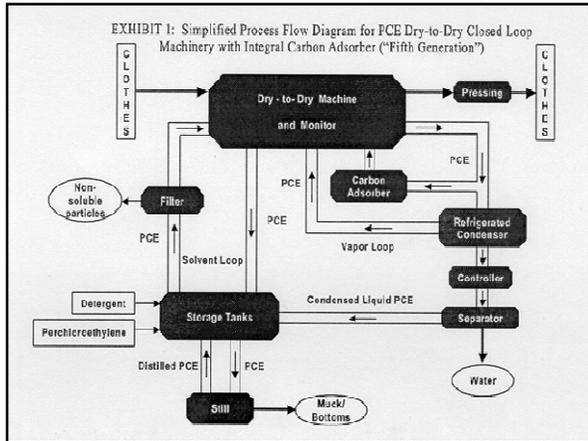
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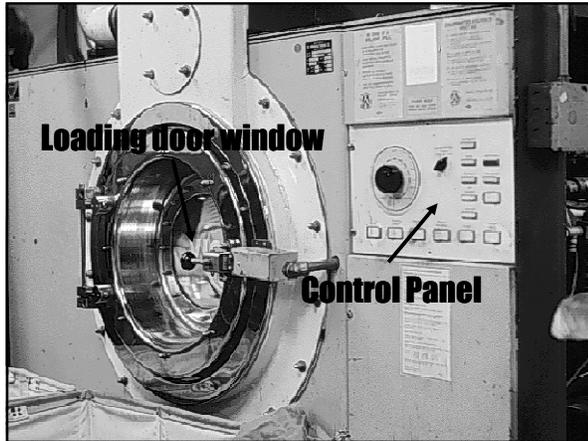
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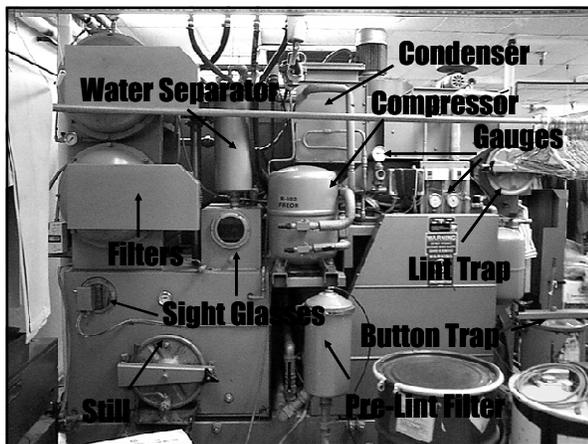
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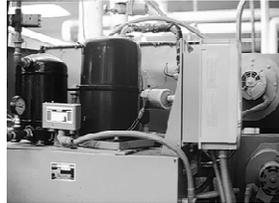
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# CARB 287 - Dry Cleaning

## Refrigerated Condensers



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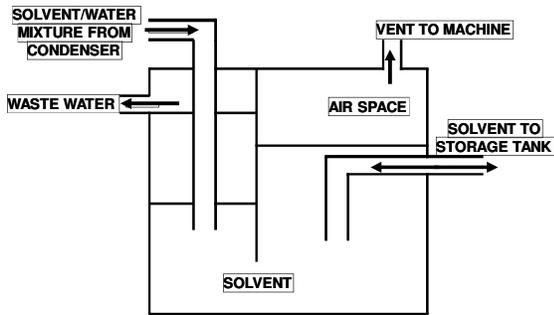
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## Water Separators



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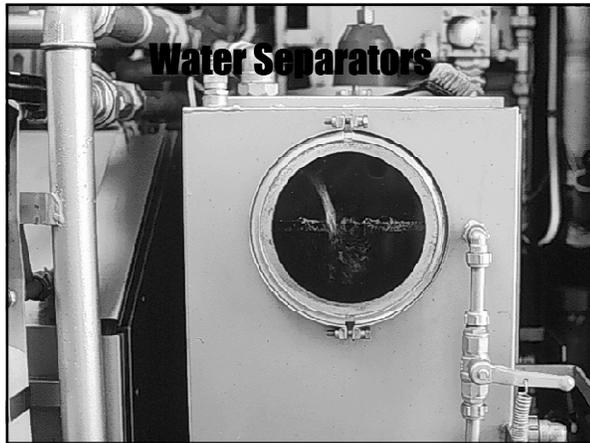
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## Water Separators

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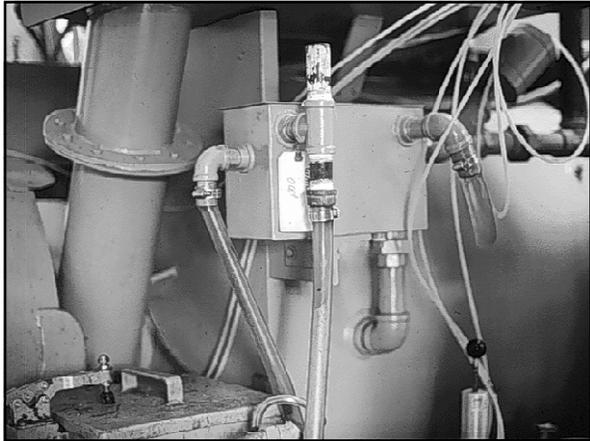
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# CARB 287 - Dry Cleaning



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## Solvent Filtration

- Purpose
- Pre Filters
- Cartridge Filtration
- Disk Filtration
- Regenerative or Flex-Tube Filters



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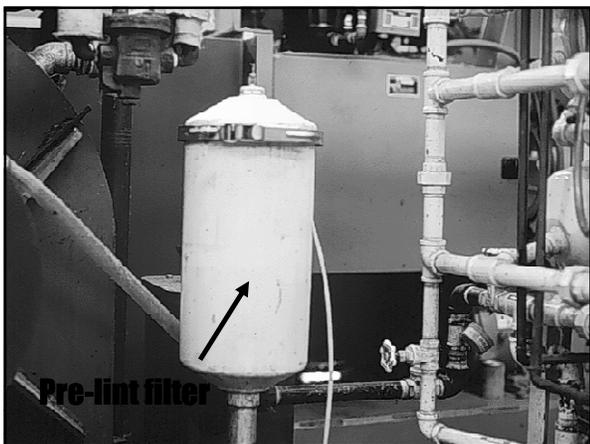
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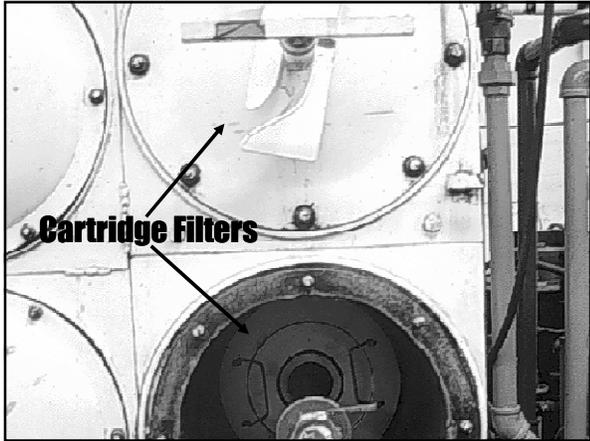
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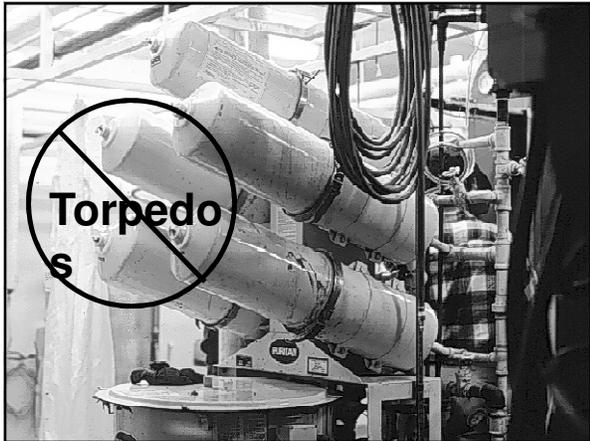
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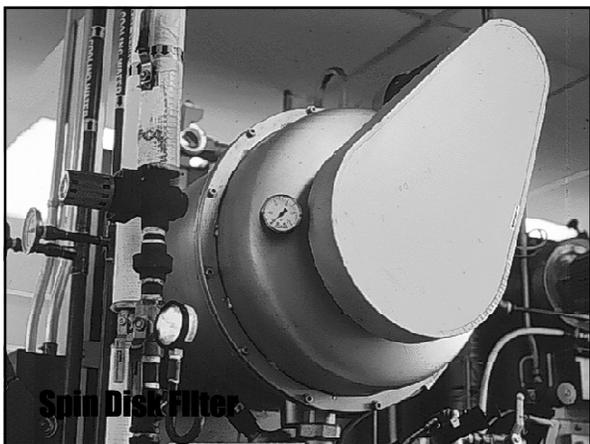
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# CARB 287 - Dry Cleaning



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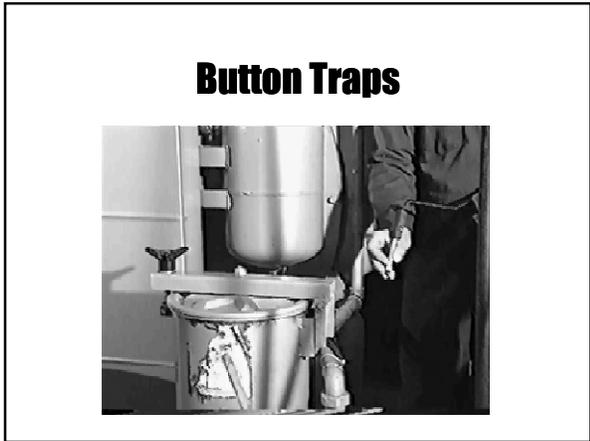
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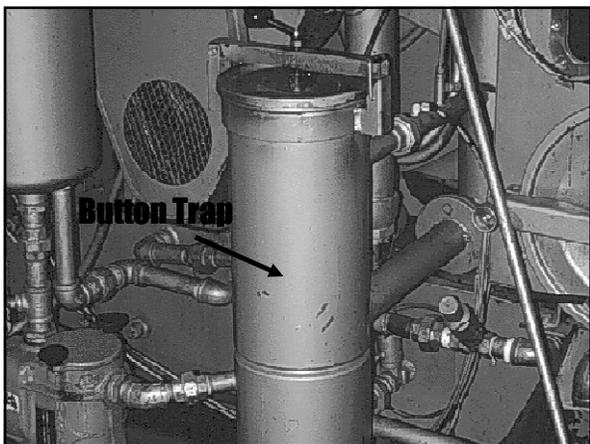
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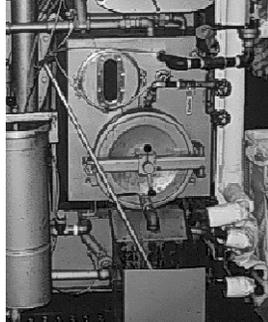
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# CARB 287 - Dry Cleaning

## Stills

- Distillation
- PERC Recovery
- 75% Capacity
- Muck Cookers
- Hazardous waste
- Azeotrope



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## Secondary Control Devices

- Vapor Adsorbers
- During End Of Cool Down Cycle
- Decreases Emissions
- Lowers Operator Exposure

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# CARB 287 - Dry Cleaning

## Misc. Equipment & Operations

- Water Separators
- Inductive Door Fans
- Spill Containment Systems
- Ventilation/Exhaust Systems
- Drying Cabinet
- Water Repelling Operations

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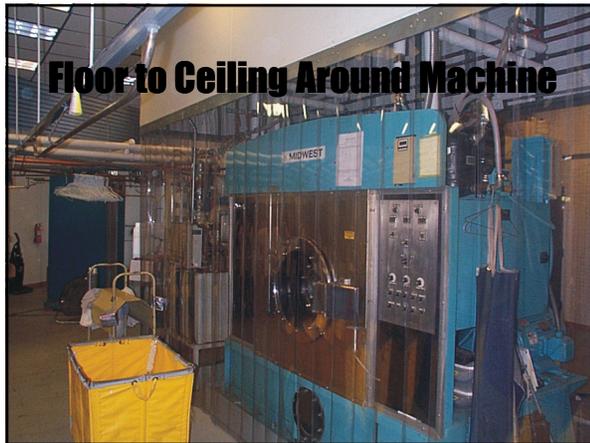
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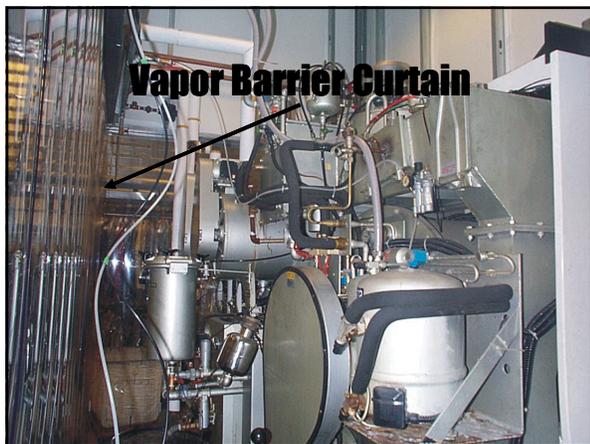
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# CARB 287 - Dry Cleaning



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## Waste Water Treatment Units

- What are They?
- Why Use One?
- How Do They Work?
- What Types Are There?

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# CARB 287 - Dry Cleaning

## Emissions From Dry Cleaners

- Door Fan Emissions



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## Federal Air Regulations

- National Perchloroethylene Air Emission Standards for Dry Cleaning Facilities  
40 CFR 63 Subpart M
- Standards of Performance for Petroleum Drycleaners  
40 CFR 60 Subpart JJJ

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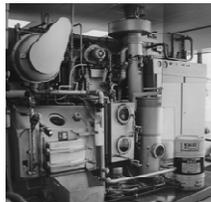
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## 40 CFR 63 Subpart M Dry Cleaning MACT

- Applicability
- Standards
- Monitoring
- Reporting
- Recordkeeping



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# CARB 287 - Dry Cleaning

## Applicability

- Dry Cleaning systems using PERC
- Many construction, reconstruction and installation dates in regulation but only a few matter

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## Applicability Dates

- Transfer machines banned as of July 28, 2008
- Small area source dry to dry installed prior to or after 12/9/91 have different control requirements
- All other sources should already be in compliance with regulation

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## Applicability Source Classification

Classification	Perc purchases (gallon/year)
Small Area	Less than 140
Large Area	140-2100
Major	Greater than 2100

**Annual Perc purchases calculated on a 12 month rolling total**

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# CARB 287 - Dry Cleaning

## **Applicability**

- Comply with new requirements within 180 days of moving up in classification
- Coin-ops exempt
- Area sources not subject to Title V unless major for something else

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## **Standards**

### **All Source Classifications**

- Dry to dry installed after 9/22/93 need refrigerated condenser.
- Dry to dry installed between 12/9/91 and 9/22/93 need refrigerated condenser or carbon absorber.
- Small area dry to dry installed prior to 12/9/91 need NO control

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## **Standards**

### **All Source Classifications**

- Close door immediately after transferring articles and keep closed at all other times
- Maintain equipment according to manufacturers specs and recommendations
- Drain all cartridge filters in sealed container for 24 hours or equiv. before removing from facility

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# CARB 287 - Dry Cleaning

## **Standards**

### **All Source Classifications**

- Store all PCE and PCE wastes in containers with no perceptible leaks

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## **Standards**

### **All Source Classifications**

- Weekly (biweekly for small area) inspection for perceptible leaks while operating for: hose and pipe connections and valves, door gaskets, filter gaskets, pumps, solvent tanks and containers, water separators, muck cookers, stills, exhaust dampers, diverter valves, filter housings

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## **Standards**

### **All Source Classifications**

- Monthly vapor leak monitoring for all components while operating.
- Area sources may use halogenated hydrocarbon detector or PCE gas analyzer.
- Majors must use PCE gas analyzer and EPA Method 21.

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# CARB 287 - Dry Cleaning

## **Standards**

### **All Source Classifications**

- Repair all perceptible or monitored leaks within 24 hours of detection.
- If repair parts need to be ordered, order within 2 working days and install within 5 working days of receipt

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## **Standards**

### **All Source Classifications**

- Perceptible Leak – Leak detected by odor, sight, or feel.
- Monitored Leak – Instrument that alarms or shows perc values of 25ppm

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## **Standards**

### **Major Sources**

- Pass perc vapor from inside machine through a carbon absorber immediately before or as the door of the machine is opened

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# CARB 287 - Dry Cleaning

## **Standards**

### **Refrigerated Condensers**

- Operate to not vent perc vapor stream to atmosphere while drum is rotating
- Prevent air drawn into machine when door is open from passing through condenser

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## **Standards**

### **Refrigerated Condensers**

- Monitor weekly at outlet side of condenser before end of cool-down or drying cycle with temperature sensor to determine if temp is equal or less than 45 degree F.
- Can also monitor pressures of refrigeration system

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## **Standards**

### **Carbon Absorbers**

- Operate to not vent perc vapor stream to atmosphere at any time
- Weekly monitoring with colorimetric detector tube or PCE gas analyzer
- For 91-93 machines and absorbers used immediately upon opening of doors, limit is 100 ppm at absorber outlet

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# CARB 287 - Dry Cleaning

## **Standards**

### **Carbon Absorbers**

- For machines that pass vapor through absorber prior to opening door, limit is 300 ppm at a location above clothes at the rear of the drum immediately upon opening door.

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## **Standards**

### **Control Equipment Repairs**

- For monitored parameters not meeting limits, adjustments or repairs shall be made to meet limits
- If repair parts are needed, they must be ordered within 2 working days and installed within 5 working days of receipt.

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## **Standards**

### **Co-Location with Residential**

- Residential means dwellings other than short term such as hotels, whether occupied or not
- Systems installed after 12/21/2005 cannot use perc
- All other perc systems must be removed by 12/21/2020

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# CARB 287 - Dry Cleaning

## Reporting

- Initial Notification report
- Notification of compliance status
- Notice of exceeding consumption limit

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## Recordkeeping

- Perc purchases and 12 month rolling total purchases
- Inspection log
- Leaking equipment and repair log
- Control equipment monitoring log
- Keep for 5 years
- Keep design specs and operating manuals onsite

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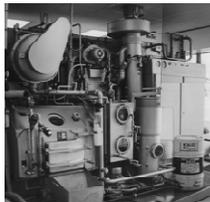
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## 40 CFR 60 Subpart JJJ Petroleum NSPS

- Applicability
- Standards
- Monitoring
- Recordkeeping



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# CARB 287 - Dry Cleaning

## Applicability

- Petroleum dry cleaning plants with total manufacturer's rated dryer capacity equal to or greater than 84 pounds

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## Standards

- All dryers shall be solvent recovery dryers
- Dryers shall be properly installed, operated and maintained

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## Standards

- Cartridge filters shall be drained for 8 hours prior to removal
- Manufacturers must provide leak inspection and repair procedures and recommend inspections every 15 days

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# CARB 287 - Dry Cleaning

## Standards

- Perform initial performance test to demonstrate that recovery rate of solvent at end of cycle is no greater than 0.05 liters per minute

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## Recordkeeping

- Keep record of initial performance test

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## Other Regulatory Requirements

- Transferring - Contaminated Waste
- Transferring Lint & Used Cartridge
- Storing Waste
- RCRA
- Wastewater



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# CARB 287 - Dry Cleaning

## New Technologies

- Wet Cleaning
- Liquid CO<sub>2</sub>
- Ultrasonic
- New Solvents



The diagram illustrates a wet cleaning cycle. It shows a 'Cleaning Vessel' containing 'Drycleaning Fluid' and 'Detergent'. The fluid is pumped to a 'Washing Machine' and then to a 'Drying Machine'. The fluid is then recovered and recycled. Below the diagram is a photograph of a wet cleaning machine.

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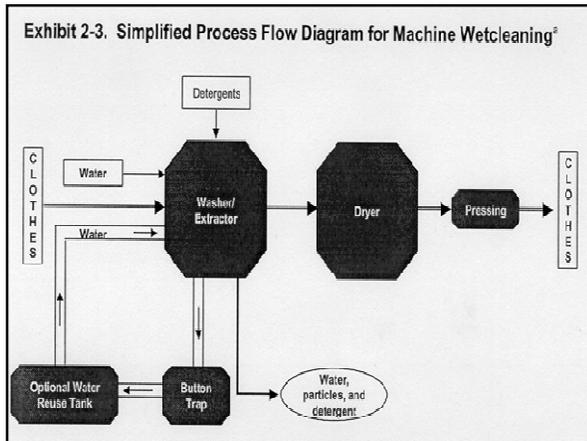
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## Liquid Carbon Dioxide

- LCO<sub>2</sub>
- Jet Agitation
- High Pressure (1000 psi)



The photograph shows a large, industrial-looking machine with a circular door and a control panel, used for liquid carbon dioxide dry cleaning.

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# CARB 287 - Dry Cleaning

## Ultrasonic Cleaning

- Aqueous Based
- Surfactants and Detergents
- Electrical Pulses Dislodges Insoluble Particles
- Temp. 90-122°F
- Research Since 1993

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## Alternative Solvents

- Silicone-Based (Green Earth)
- Glycol Ether (Rynex) and others



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## Silicone-based Solvent

- **Advantages:**
  - Not Regulated as a Toxic, Non VOC
  - High Flash Point (170 F)
  - Safe For Delicate Garms
  - No Permitting Required
- **Disadvantages:**
  - Does Not Clean As Well As Perc
  - Problems With Water Separation
  - Requires A Modified Hydrocarbon Machine



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# CARB 287 - Dry Cleaning

## Glycol Ether Solvent

- **Advantages:**

- Not Regulated as a Toxic
- Excellent For Water Soluble
- High Flash Point (>200 F)



- **Disadvantages:**

- Standard D2D Machine Requires A \$20,000 Conversion Kit
- Does Not Clean All Garments Well

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## Other Alternative Solvents

- ExxonMobil DF-2000<sup>1</sup>: synthetic hydrocarbon, CAS 64742-48-9
- Chevron Philips EcoSolv<sup>®1</sup>: highly refined hydrocarbon, CAS 68551-17-7
- Sasol (LPA-142)<sup>1</sup>: highly refined hydrocarbon, CAS 64742-47-8
- SolvonK4<sup>™</sup>: dibutoxymethane, CAS 2568-90-3, by Kreussler
- DC-142<sup>1</sup>: aliphatic hydrocarbon solvent, CAS 64742-88-7, by Essential Solvents

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## Inspection of The Facility

- What Will the Inspector Have?
  - Permits and Inspection Forms
  - Complaint History
  - Safety Equipment
  - Monitoring Equip.



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# CARB 287 - Dry Cleaning

## Inspector's Thoughts Entering Facility

- Do I Smell PERC?
- Is The Shop Clean?
- Is The PTO Visible?
- "Wall to Wall"
- Trained Operator Present?

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## The Inspection

- Verify Equipment and Current Owners
- Conduct Leak Inspections
- Check For Closed Containers
- Verify Refrigerated Condenser
- Check Air Records
- Review The Inspection Results



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## What Records Should The Inspector Ask To See ?

- Operations & Maintenance Log
- Weekly Leak Inspection Log
- PERC Purchase Receipts
- Hazardous Waste Manifests
- Permit To Operate



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# CARB 287 - Dry Cleaning

## What About Violations ?

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



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## What About Violations ?

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



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## Notice Of Violation

- Purchased Too Much PERC
- No Hydrocarbon Detector On-Site
- Missing Or Incomplete Records To Determine PERC Usage
- Open Container With PERC In It
- Same Violation As Last Inspection

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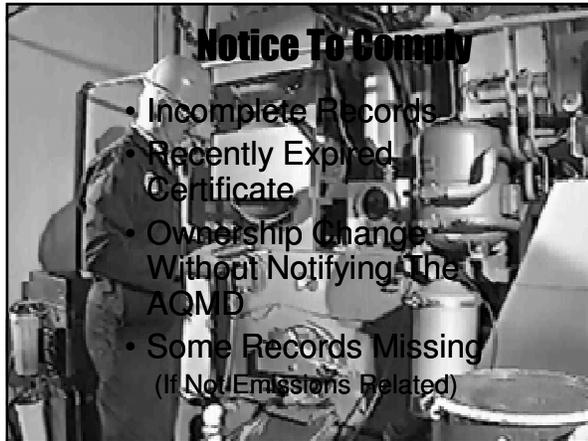
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# CARB 287 - Dry Cleaning

**Notice To Comply**

- Incomplete Records
- Recently Expired Certificate
- Ownership Change Without Notifying The AQMD
- Some Records Missing (If Not Emissions Related)



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**Vapor Leak Inspections**

- Definitions
- Halogenated Hydrocarbon Detector
- Areas To Check
- When To Check
- How Do You Do It?
- If a Leak is Found?



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**Vapor Leak Inspections**

- Check Halogen Detector
- Tip Within 1 cm
- Slow & Direct
- Check All Opening & Gaskets
- Check Machine While Running



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# CARB 287 - Dry Cleaning

## Summary of Components Most Likely to Leak

Component	Typical ppm	Leaks Found %	Reason for leak	Ranking
Loading Door	10-35	55%	Gasket	1st
Still	300	33%	Cover & Sight Glass	2nd
Lint Trap	120	25%	General & Gasket	3rd
Button Trap	20	14%	General & Gasket	4th
Water Separator	10	12%	Not Specified	5th
All Others	Varies	<5%	Not Specified	6th-14th

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**Vapor Leak Inspections**

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## What Happens When a Leak Is Found?

- Fix Component
- Order Parts
- Installing Parts
- Extensions




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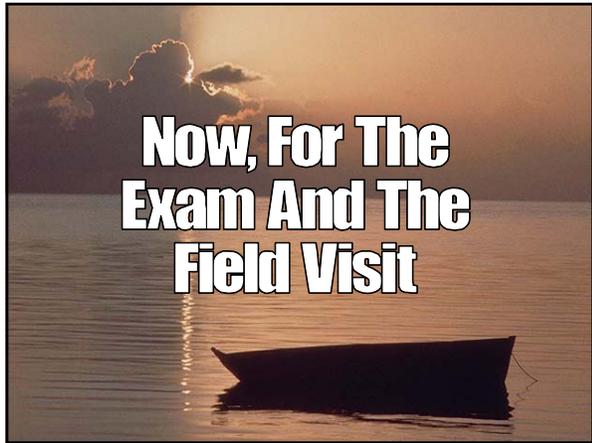
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# CARB 287 - Dry Cleaning



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