

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
OFFICE OF AIR RESOURCES

AIR POLLUTION CONTROL REGULATION NO. 36

CONTROL OF EMISSIONS  
FROM ORGANIC SOLVENT CLEANING

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**CONTROL OF EMISSIONS FROM ORGANIC SOLVENT CLEANING**

**36. Control of Emissions from Organic Solvent Cleaning**

**36.1 Definitions**

Unless otherwise expressly defined in this section, the terms used in this regulation shall be defined by reference to the Rhode Island Air Pollution Control General Definitions Regulation. As used in this regulation, the following terms shall, where the context permits, be construed as follows:

- 36.1.1 “**Air Blanket**” means the layer of air inside a solvent cleaning machine above the solvent/air interface. The centroid of the air blanket is equidistant from the sides of the machine.
- 36.1.2 “**Automated Parts Handling System**” means a mechanical device that carries all parts and parts baskets through the cleaning cycle at a controlled speed from the initial loading of contaminated or wet parts cold cleaning through the removal of the cleaned or dried parts. Automated parts handling systems include, but are not limited to, hoists and conveyors.
- 36.1.3 “**Batch Cleaning**” means the process in which individual parts or a set of parts move through an entire cleaning cycle before new parts are introduced into the solvent cleaning machine.
- 36.1.4 “**Carbon Adsorber**” means a bed of activated carbon which adsorbs solvent from an air-solvent gas-vapor stream.
- 36.1.5 “**Clean Liquid Solvent**” means fresh unused solvent, recycled solvent, or used solvent that has been cleaned of contaminants (e.g., skimmed of oils or sludge and strained of metal chips).
- 36.1.6 “**Cleaning Capacity**” means, for a cleaning machine without a solvent/air interface, the maximum volume of parts that can be cleaned at one time. In most cases, the cleaning capacity is equal to the volume (length times width times height) of the cleaning chamber.

- 36.1.7 “**Cold Cleaning**” means an organic solvent cleaning process which cleans and removes contaminants or water from surfaces by spraying, brushing, flushing, immersing, or drying parts. Cleaning machines that use heated, nonboiling solvent to clean the parts are classified as cold cleaning machines. Wipe cleaning is not included in this definition.
- 36.1.8 “**Dwell**” means the technique of holding parts within the freeboard zone but above the vapor zone of the solvent cleaning machine. Dwell is used after cleaning to allow solvent to drain from parts or parts baskets back into the solvent cleaning machine.
- 36.1.9 “**Dwell Time**” is the amount of time that a part dwells in the freeboard zone of the solvent cleaning machine.
- 36.1.10 “**Emission**” means the release or discharge, directly or indirectly, of one or more air pollutants into the air.
- 36.1.11 “**Freeboard Height**” means; for a batch cleaning machine, the distance from the solvent/air interface, measured during the idling mode, to the top of the cleaning machine; for an in-line cleaning machine, it is the distance from the solvent/air interface to the bottom of the entrance or exit opening, whichever is lower, as measured during the idling mode.
- 36.1.12 “**Freeboard Ratio**” means the freeboard height divided by the width of the smaller interior dimension of the organic solvent cleaning machine.
- 36.1.13 “**Freeboard Zone**” means; for a batch cleaning machine, the zone within the solvent cleaning machine that extends from the solvent/air interface to the top of the solvent cleaning machine; for an in-line cleaning machine, it is the zone within the solvent cleaning machine that extends from the solvent/air interface to the bottom of the entrance or exit opening, whichever is lower.
- 36.1.14 “**Hazardous Air Pollutant**” means any pollutant which has been listed pursuant to Section 112(b) of the Clean Air Act Amendments of 1990 or which is listed in Table 1 of Rhode Island Air Pollution Control Regulation No. 22.
- 36.1.15 “**Idling Mode**” means the time period when a solvent cleaning machine is not actively cleaning parts and the sump heating coils, if present, are turned on.
- 36.1.16 “**In-line Cleaning**” means an organic solvent cleaning machine that uses an automated parts handling system, typically a conveyor, to automatically provide a continuous supply of parts to be cleaned. These units are fully enclosed except for the conveyor inlet and exit openings. In-line cleaning machines can be either cold or vapor cleaning machines.

- 36.1.17 “**Leakproof Coupling**” means a threaded or other type of coupling that prevents solvents from leaking while filling or draining solvent to and from the solvent cleaning machine.
- 36.1.18 “**Lip Exhaust**” means a device installed at the top of the opening of a solvent cleaning machine that draws air and solvent vapor from the freeboard zone and removes the air and vapor from the solvent cleaning area.
- 36.1.19 “**Open Top Area**” means the solvent/air interface area which is open to the atmosphere during operations.
- 36.1.20 “**Organic Solvent Cleaning**” means the process of cleaning contaminants or water from surfaces by cold cleaning or vapor cleaning using Volatile Organic Compounds (VOC) or volatile Hazardous Air Pollutants.
- 36.1.21 “**Primary Condenser**” means a series of cooling coils on a vapor cleaning machine through which a chilled substance is circulated to provide continuous condensation of rising solvent vapors and, thereby, create a concentrated solvent vapor zone.
- 36.1.22 “**Refrigerated Freeboard Chiller**” means a control device mounted above the primary condenser coils consisting of secondary coils which carry a refrigerant to provide a chilled air blanket above the solvent vapor to reduce emissions from the solvent cleaning machine.
- 36.1.23 “**Remote-Reservoir Cold Cleaning**” means cold cleaning using equipment which pumps liquid solvent to a sink-like work area and then drains the solvent back into an enclosed container while parts are being cleaned, allowing no solvent to pool in the work area.
- 36.1.24 “**Solvent/Air Interface**” means, for a vapor cleaning machine, the location of contact between the concentrated solvent vapor layer and the air. If this location cannot be determined, it is assumed to be at the mid-line height of the primary condenser coils. For a cold cleaning machine, it is the location of contact between the liquid solvent and the air.
- 36.1.25 “**Solvent Cleaning Machine**” means any device or piece of equipment that uses solvent liquid or vapor to remove contaminants from the surfaces of materials. Types of solvent cleaning machines include, but are not limited to, batch vapor, in-line vapor, in-line cold, and batch cold solvent cleaning machines.
- 36.1.26 “**Solvent Vapor Zone**” means; for a vapor cleaning machine, the zone that extends from the liquid solvent surface to the level that solvent vapor is condensed. This condensation level is defined as the midline height of the primary condenser coils.

- 36.1.27 “**Special and extreme solvent metal cleaning**” means the use of a cold cleaning unit to clean metal parts where such metal parts are used in any of the following applications:
- (a) Research, development, manufacture and rework of electronic parts, assemblies, boxes, wiring harnesses, sensors and connectors used in aerospace service; or
  - (b) Research, development, manufacture and rework of high precision products for which contamination must be minimized in accordance with a customer or other specification.
- 36.1.28 “**Sump**” means the part of a solvent cleaning machine where the liquid solvent is located.
- 36.1.29 “**Superheated Vapor System**” means a system that heats solvent vapor to a temperature above the solvent's boiling point. Parts are held (dwell) in the superheated vapor to evaporate the liquid solvent on them before exiting the machine. Hot vapor recycle is an example of a superheated vapor system.
- 36.1.30 “**Vapor Cleaning**” means an organic solvent cleaning process in which contaminants or water are cleaned and removed from surfaces by condensing hot solvent vapor on the colder pieces. This definition includes vapor degreasing and drying.
- 36.1.31 “**Working Mode**” means the time period when the solvent cleaning machine is actively cleaning parts.

## 36.2 Applicability

- 36.2.1 The provisions of this regulation apply to any person who owns, leases, operates, or controls an organic solvent cleaning machine.
- 36.2.2 \* \* \*
- 36.2.3 The requirements in this regulation supersede the requirements in Air Pollution Control Regulation No. 18, entitled “Control of Emissions from Organic Solvent Cleaning”. A facility must continue to comply with Regulation No. 18 until the applicable compliance date for the provisions of this regulation, as specified in Section 36.3.

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*\* \* \* Note: EPA did not approve Section 36.2.2 which the state did not submit as part of the SIP revision.*

- 36.2.4 The requirements in Section 36.5 shall not apply to any cold cleaning unit that uses a solvent which contains no more than 5% VOC or volatile HAP by weight

### **36.3 Compliance Schedule**

Unless otherwise specified compliance with the provisions of this regulation shall be achieved by the following dates:

- (a) Solvent cleaning machines that commenced construction or reconstruction before November 29, 1993, shall achieve compliance with this regulation by January 1, 1997.
- (b) Solvent cleaning machines that commenced construction or reconstruction on or after November 29, 1993, shall achieve compliance with this regulation immediately upon startup or by April 8, 1996, whichever is later.
- (c) Any batch vapor cleaning machine with a solvent/air interface that uses trans 1,2-dichloroethene or n-propyl bromide shall achieve compliance with subsections 36.6.3, 36.6.6 and 36.6.7 of this regulation immediately upon first use of that solvent or by April 9, 2009, whichever is later.

### **36.4 General Requirements**

- 36.4.1 Equipment covers and dipping or rotating baskets must be constructed of nonporous or nonabsorbent material. Covers must form a tight seal with the sides of the solvent cleaning machine and have no gaps or holes.
- 36.4.2 When the solvent cleaning machine cover is open, drafts at the same elevation as the tank lip must not be greater than 40 m/min. (130 ft/min.) when measured 1 to 2 meters (3 to 7 feet) upwind.
- 36.4.3 Leaks must be repaired immediately or the solvent cleaning unit shut down.
- 36.4.4 Equipment used in solvent cleaning must display a conspicuous summary of proper operating procedures consistent with minimizing emissions of organic solvents.
- 36.4.5 Any solvent spray must be a solid, fluid stream which is delivered at a pressure no greater than 10 pounds per square inch (psi) and which does not cause excessive splashing. For purposes of this regulation, no solvent spray shall be an atomized or shower spray.
- 36.4.6 Spills shall be wiped up immediately. The wipe rags shall be stored in covered containers meeting the specifications in Subsection 36.4.12.

- 36.4.7 No porous or absorbent materials, such as sponges, fabrics, wood, or paper products, shall be placed in an organic cleaning machine.
- 36.4.8 Parts baskets or parts shall be drained under the cover and shall not be removed from the cleaning machine for at least 15 seconds or until dripping ceases and the pieces are visually dry, whichever is longer.
- 36.4.9 Parts having cavities or blind holes shall be tipped or rotated while draining before being removed from the vapor zone and shall.
- 36.4.10 Parts shall be oriented for best drainage.
- 36.4.11 When solvent is added to or drained from a solvent cleaning machine, the solvent shall be transferred using threaded or other leakproof couplings and the end of the pipe in the solvent sump shall be located beneath the liquid solvent surface.
- 36.4.12 Solvent, waste solvent, still bottoms, and sump bottoms must be stored in covered containers and waste solvent transferral or disposal must allow less than 20 percent of the waste solvent (by weight) to evaporate into the atmosphere. The closed containers may contain a device that allows for pressure relief, providing that the device does not allow liquid solvent to drain from the containers.
- 36.4.13 Each solvent cleaning machine and related air pollution control equipment shall be maintained as recommended by the manufacturer of the equipment.
- 36.4.14 Operators must receive training in proper solvent cleaning procedures and, if requested by representatives of the Department or the EPA during an inspection, must complete and pass the applicable sections of the test on those procedures in Appendix A.
- 36.4.15 No work area fans shall be located and positioned so that they blow across the opening of a solvent cleaning machine.
- 36.4.16 No degreaser units shall be located and positioned so that ventilation from an open window blows across the opening of the solvent cleaning machine.
- 36.4.17 Facility wide emissions of Hazardous Air Pollutants (HAPs) from organic solvent cleaning operations shall not exceed 1,500 pounds of any one (1) HAP or 4,000 pounds of any combination of HAPs per calendar month, based upon a 12 month rolling average unless a greater quantity of HAP emissions is allowed by an operating permit issued pursuant to Air Pollution Control Regulation No. 29. In no case shall emissions exceed the facility wide emission limits specified in 40 CFR Part 63.471.

### **36.5 Requirements for Batch Cold Cleaning Operations**

- 36.5.1 Cleaning machines shall be equipped with an attached cover that can be operated easily with one hand. Covers must be closed at all times except during parts entry and removal. If the cold cleaning machine is equipped with a lip exhaust, the cover shall be located below the lip exhaust.
- 36.5.2 The solvent sump of a remote-reservoir batch cold cleaning machine must be equipped with a tight fitting cover that is kept closed at all times except during the cleaning of parts.
- 36.5.3 One of the following techniques shall be used to control solvent emissions from batch cold cleaning operations:
- (a) A freeboard ratio greater than or equal to 0.75; or
  - (b) Another system of equivalent control that is approved by the Director and the EPA. Requests for equivalency determinations for control of cleaning machines installed before November 29, 1993 must be submitted no later than June 3, 1996. Requests for equivalency determinations for control of cleaning machines installed on or after November 29, 1993 must be submitted and approved prior to startup of the cleaning machine. Requests shall include the following information:
    - (1) A complete description of process and control equipment;
    - (2) Testing procedures that will be used to demonstrate equivalency; and
    - (3) The date, time and location of the equivalency test.
- 36.5.4 If a flexible hose or flushing device is used, flushing shall be performed only within the freeboard zone of the cold cleaning machine.
- 36.5.5 When an air- or pump-agitated solvent bath is used, the agitator shall be operated so that a rolling motion of the solvent is produced and splashing against the tank or parts being cleaned does not occur.
- 36.5.6 The height of solvent in a batch cold cleaner shall not exceed the manufacturer's fill-line for that machine.
- 36.5.7 After April 1, 2009, no cold cleaning operation shall use a solvent with a vapor pressure equal to or greater than 1.0 millimeters of mercury (mm Hg), measured at 20° C (68°F). The following are exempt from this requirement:
- (a) A cold cleaning unit with an internal volume of 1 liter or less;



- (b) A cold cleaning unit used for special and extreme solvent cleaning, as defined in Subsection 36.1.27, with the Director's approval;
- (c) A cold cleaning unit which cannot be operated safely using a solvent that complies with the vapor pressure limit in 36.5.7, with the Director's approval.
- (d) A cold cleaning unit operated in a permanent total enclosure equipped with an air pollution control system with an overall VOC removal efficiency of 90% or greater, with the Director's approval.

### **36.6 Requirements for Batch Vapor Cleaning Operations With Solvent/Air Interfaces**

- 36.6.1 Vapor cleaning machines shall be equipped with a cover that can be easily operated without disturbing the vapor zone and that is attached to the vapor cleaning machine. Covers must be closed at all times except during parts entry and removal. If the batch vapor cleaning machine is equipped with a lip exhaust, the cover must be located below the lip exhaust.
- 36.6.2 Each vapor cleaning machine shall be equipped with a primary condenser.
- 36.6.3 Each vapor cleaning machine, except those exempted as specified in Section 36.12, which uses a solvent containing trichloroethylene, perchloroethylene, 1,1,1-trichloroethane, methylene chloride, chloroform, trans 1,2-dichloroethene, n-propyl bromide, or carbon tetrachloride shall be equipped with an automated parts handling system, such as, but not limited to, a hoist or conveyor, that maintains a vertical conveyor speed of less than 2 inches per second (10 feet per minute).
- 36.6.4 Each vapor cleaning machine must be equipped with the following safety switches:
  - (a) A condenser flow switch and thermostat to shut off the heat to the solvent if the condenser coolant is not circulating; and
  - (b) A vapor level control thermostat to shut off the heat when the vapor level rises above the height of the primary cooling coils; and
  - (c) If the cleaning machine is equipped with a spray apparatus, a spray safety switch to shut off the spray pump if the vapor level drops more than 4 inches (10 cm) from the bottom of the primary condenser coil and to prevent spraying outside the vapor level; and
  - (d) A low solvent level safety switch to shut off the heating element if it should become exposed.

- 36.6.5 Each vapor cleaning machine shall have a freeboard ratio of at least 0.75.
- 36.6.6 Any vapor cleaning machine that has a solvent/air interface of 13 square feet (1.21 square meters) or less and uses a solvent containing trichloroethylene, perchloroethylene, 1,1,1-trichloroethane, methylene chloride, chloroform, trans 1,2-dichloroethene, n-propyl bromide, or carbon tetrachloride must be equipped with one of the following control combinations:
- (a) Refrigerated freeboard chiller and superheated vapor system; or
  - (b) Refrigerated freeboard chiller and freeboard ratio of at least 1.0; or
  - (c) Refrigerated freeboard chiller and carbon adsorber; or
  - (d) Refrigerated freeboard chiller and dwell; or
  - (e) Another system of equivalent control that is approved by the Director and the EPA. Requests for equivalency determinations for control of cleaning machines installed before November 29, 1993 must be submitted no later than June 3, 1996. Requests for equivalency determinations for control of cleaning machines installed on or after November 29, 1993 must be submitted and approved prior to startup of the cleaning machine. Requests shall include the following information:
    - (1) A complete description of process and control equipment;
    - (2) Testing procedures that will be used to demonstrate equivalency; and
    - (3) The date, time and location of the equivalency test.
- 36.6.7 Any vapor cleaning machine that has a solvent/air interface of greater than 13 square feet (1.21 square meters) and uses a solvent containing trichloroethylene, perchloroethylene, 1,1,1-trichloroethane, methylene chloride, chloroform, trans 1,2-dichloroethene, n-propyl bromide, or carbon tetrachloride must be equipped with one of the following control combinations:
- (a) Refrigerated freeboard chiller, freeboard ratio of at least 1.0, and superheated vapor system; or
  - (b) Refrigerated freeboard chiller, superheated vapor system, and carbon adsorber; or

(c) Another system of equivalent control that is approved by the Director and the EPA. Requests for equivalency determinations for control of cleaning machines installed before November 29, 1993 must be submitted no later than June 3, 1996. Requests for equivalency determinations for control of cleaning machines installed on or after November 29, 1993 must be submitted and approved prior to startup of the cleaning machine. Requests shall include the following information:

- (1) A complete description of process and control equipment;
- (2) Testing procedures that will be used to demonstrate equivalency; and
- (3) The date, time and location of the equivalency test.

36.6.8 Pieces shall be held in the vapor zone for at least 30 seconds or until condensation ceases, whichever is longer.

36.6.9 The workload shall not occupy more than half of the cleaning machine's open top area.

36.6.10 The vapor level shall not rise or drop more than 4 inches (10 cm) when the workload enters or is removed from the vapor zone.

36.6.11 Sprays shall be used only within the vapor zone.

36.6.12 Cleaning machines shall be operated so that water cannot be visually detected in the solvent exiting the water separator.

36.6.13 Each cleaning machine that uses a lip exhaust shall be designed and operated to route all collected solvent vapors through a properly operated and maintained carbon adsorber that meets the requirements of Subsection 36.9.5.

36.6.14 The exhaust ventilation rate shall not exceed  $20 \text{ m}^3/\text{min}$  per  $\text{m}^2$  (65 cfm per  $\text{ft}^2$ ) of solvent/air interface, unless necessary to meet OSHA requirements. If a carbon adsorber is used to meet the requirements of Subsection 36.6.6 or 36.6.7, the exhaust ventilation rate shall be at least  $15 \text{ m}^3/\text{min}$  per  $\text{m}^2$  (50 cfm per  $\text{ft}^2$ ) of solvent/air interface.

36.6.15 During startup of each vapor cleaning machine, the primary condenser shall be turned on before the sump heater.

36.6.16 During shutdown of each vapor cleaning machine, the sump heater shall be turned off and the solvent vapor layer allowed to collapse before the primary condenser is turned off.

36.6.17 To minimize solvent carry-out, pieces shall be removed from the vapor cleaning machine at a rate less than 2 inches per second (10 feet per minute).

### **36.7 Requirements for In-line Cleaning Operations**

36.7.1 Cleaning machines must be equipped with covers that completely cover machine openings. Covers must be in place at all times when the conveyors and exhausts are not being operated. If the cleaning machine is equipped with a lip exhaust, the cover must be located below the lip exhaust.

36.7.2 Each in-line vapor cleaning machine shall have a primary condenser.

36.7.3 The automated parts handling system shall move parts at a speed of no more than 2 inches per second (10 feet per minute).

36.7.4 The following safety switches must be installed and operated:

- (a) A condenser flow switch to shut off the heat if the condenser coolant is not circulating; and
- (b) A vapor level control thermostat to shut off the heat when the vapor level rises above the height of the primary cooling coils; and
- (c) If the cleaning machine is equipped with a spray apparatus, a spray safety switch to shut off the spray pump or conveyor if the vapor level drops more than 4 inches (10 cm) from the bottom of the primary condenser coil and to prevent spraying outside the vapor level; and
- (d) A low solvent level safety switch to shut off the heating element if it should become exposed.

36.7.5 Each in-line cleaning machine shall have a freeboard ratio of at least 0.75.

36.7.6 Each in-line cleaning machine must be equipped with a drying tunnel, a rotating (tumbling) basket, or another device that prevents cleaned pieces from carrying solvent liquid or vapor out of the unit.

36.7.7 Any in-line cleaning machine installed before November 29, 1993 must be equipped with one of the following control combinations:

- (a) Refrigerated freeboard chiller and freeboard ratio of at least 1.0; or
- (b) Refrigerated freeboard chiller and dwell; or
- (c) Carbon adsorber and dwell; or
- (d) Another system of equivalent control system that is approved by the Director and the EPA. Requests for equivalency determinations must be submitted no later than June 3, 1996. Requests shall include the following information:
  - (1) A complete description of process and control equipment;
  - (2) Testing procedures that will be used to demonstrate equivalency; and
  - (3) The date, time and location of the equivalency test.

36.7.8 Any in-line cleaning machine installed on or after November 29, 1993 must be equipped with and operate one of the following control combinations:

- (a) Refrigerated freeboard chiller and a superheated vapor system; or
- (b) Refrigerated freeboard chiller and carbon adsorber; or
- (c) Another system of equivalent control that is approved by the Director and the EPA. Requests for equivalency determinations for control of cleaning machines installed on or after November 29, 1993 must be submitted and approved prior to startup of the cleaning machine. Requests shall include the following information:
  - (1) A complete description of process and control equipment;
  - (2) Testing procedures that will be used to demonstrate equivalency; and
  - (3) The date, time and location of the equivalency test.

36.7.9 The size of entrance and exit openings shall be minimized so that there is a clearance of no more than four inches on each side between the largest piece cleaned and the edges of the opening of the cleaning machine.

- 36.7.10 Each in-line cleaning machine that uses a lip exhaust shall be designed and operated to route all collected solvent vapors through a properly operated and maintained carbon adsorber that meets the requirements of Subsection 36.9.5.
- 36.7.11 The exhaust ventilation rate shall not exceed 20 m<sup>3</sup>/min per m<sup>2</sup> (65 cfm per ft<sup>2</sup>) of solvent/air interface, unless necessary to meet OSHA requirements. If a carbon adsorber is used to meet the requirements of Subsection 36.7.7 or 36.7.8, the exhaust ventilation rate shall be at least 15 m<sup>3</sup>/min per m<sup>2</sup> (50 cfm per ft<sup>2</sup>) of solvent/air interface.
- 36.7.12 The cleaning machine shall be operated so that water cannot be visually detected in the solvent exiting the water separator.
- 36.7.13 During startup of each vapor in-line cleaning machine, the primary condenser shall be turned on before the sump heater.
- 36.7.14 During shutdown of each vapor in-line cleaning machine, the sump heater shall be turned off and the solvent vapor layer allowed to collapse before the primary condenser is turned off.
- 36.7.15 Any spraying operations shall be done only within the vapor zone or within a section of the in-line cleaning machine that is not directly exposed to the room air.

**36.8 Requirements for Batch Vapor Cleaning Operations Without Solvent/Air Interfaces**

The owner or operator of a batch vapor cleaning machine which does not have a solvent/air interface must comply with the requirements specified below.

- 36.8.1 A log of solvent additions and deletions shall be maintained for each cleaning machine.
- 36.8.2 Solvent emissions from each cleaning machine which does not have a solvent/air interface shall not exceed the amount calculated using Equation 1:

$$EL = 85.5 * (Vol)^{0.6} \quad \text{Equation 1}$$

Where:

EL = the average monthly emission limit for any three month period (pounds/month)

Vol = the cleaning capacity (volume) of the cleaning machine (cubic feet)

36.8.3 The owner or operator of a batch vapor cleaning machine that does not have a solvent/air interface shall demonstrate compliance with the emission limit calculated with Equation 1 on the first operating day of every month using the following procedure:

- (a) A fill-line must be marked on the first month the measurements are taken. Solvent shall be added to bring the level to the same fill-line on the first operating day of each month thereafter; and
- (b) Confirm that only clean liquid solvent is in the vapor cleaning machine; and
- (c) Using the records of solvent additions and deletions for the previous month required in Subsection 36.8.1 and Equation 2, determine monthly solvent emissions:

$$E = SA - LSR - SSR \quad \text{Equation 2}$$

Where:

E = the total solvent emissions for the previous month (pounds)

SA = the total amount of solvent added to the cleaning machine during the previous month (pounds)

LSR = the total amount of liquid solvent removed from the cleaning machine during the previous month (pounds)

SSR = the total amount of solid waste removed from the cleaning machine during the previous month (pounds)

- (d) The SSR should be determined using either engineering calculations or EPA reference method 25d.
- (e) The average monthly emissions for the previous three month period shall be calculated according to Equation 3:

$$E_{3\text{-month}} = \frac{E_1 + E_2 + E_3}{3} \quad \text{Equation 3}$$

Where:

$E_{3\text{-month}}$  = average monthly solvent emissions during the previous three month period.

$E_1, E_2, E_3$  = solvent emissions for each of the three most recent months, calculated using Equation 2.

- (f) The cleaning machine is in compliance with the average monthly emission limit if  $E_{3\text{-month}}$ , calculated using Equation 3, is less than or equal to EL, calculated according to Equation 1.

### **36.9 Compliance Specifications and Monitoring Requirements**

The owner or operator of a solvent cleaning machine shall monitor the following parameters and record the results:

- 36.9.1 The cover of each batch vapor or in-line cleaning machine shall be visually inspected monthly to confirm that it is opening and closing properly, that it completely covers the cleaning machine's openings when closed, and that it is free of cracks, holes, and other defects.
- 36.9.2 The speed of automated parts handling systems shall be monitored according to the following specifications:
  - (a) Determine the speed by measuring the time it takes for the conveyor to travel a measured distance. The speed is the distance in inches divided by the time in seconds, or the distance in feet divided by the time in minutes; and
  - (b) Monitoring shall be performed on a monthly basis. If no exceedances of the speed requirements specified in Subsection 36.6.3 and 36.7.3 occur in a year, then future hoist speed monitoring may be conducted on a quarterly basis; and
  - (c) If a speed greater than that specified in Subsections 36.6.3 and 36.7.3 is measured, the automated parts handling system must be adjusted so that this specification is met; and
  - (d) If a speed greater than that specified in Subsections 36.6.3 and 36.7.3 is measured while monitoring is being conducted on a quarterly basis, then monthly monitoring must be resumed until another year passes without any exceedances.
- 36.9.3 If a refrigerated freeboard chiller is used, the temperature at the coldest point of the centroid of the chilled air blanket shall be no greater than 30% of the solvent's boiling point, measured in °F, and shall be monitored weekly according to the following specifications:



- (a) The temperature shall be monitored while the batch vapor or in-line cleaning machine is operating in the idling mode; and
- (b) A thermometer or thermocouple shall be used to measure the temperature at the centroid of the air blanket; and
- (c) If the temperature at the coldest point of the centroid of the air blanket exceeds 30% of the solvent's boiling point, measured in °F, the chiller shall be adjusted so that this specification is met.

36.9.4 If a superheated vapor system is used, the temperature of the solvent vapor at the centroid of the superheated vapor zone shall be maintained at least 10°F above the solvent's boiling point and shall be monitored weekly according to the following specifications:

- (a) The temperature shall be monitored while the batch vapor or in-line cleaning machine is operating in the idling mode; and
- (b) A thermometer or thermocouple shall be used to measure the temperature at the centroid of the superheated solvent vapor zone; and
- (c) If the temperature at the centroid of the air blanket is less than 10°F above the solvent's boiling point, the system shall be adjusted so that this specification is met.

36.9.5 If a carbon adsorber is used, the concentration of solvent in the exhaust shall not exceed 25 ppm. Compliance with this requirement shall be determined using the following methods:

- (a) Within 60 days of initial startup of the carbon adsorber, the solvent concentration in the carbon adsorber exhaust shall be tested using EPA Test Method 25. Each test shall consist of 3 separate one-hour samples, and the arithmetic mean shall be used to determine initial compliance. The results shall be reported to the Office of Air Resources within 60 days of the test.
- (b) Continuing compliance shall be determined weekly using the following procedure:
  - (1) The concentration of solvent in the exhaust shall be measured while the cleaning machine is in the working mode and is exhausting to the carbon adsorber; and

- (2) An easily accessible sampling port shall be provided that is located on the exhaust outlet at least 8 stack or duct diameters downstream and 2 stack or duct diameters upstream of any flow disturbance such as a bend, expansion, contraction, or outlet. The sampling port must not be downstream of any other inlet; and
- (3) Solvent concentration shall be measured at the sampling port using a colorimetric detector tube capable of detecting 25 ppm with an accuracy of  $\pm 25\%$  or better; and
- (4) Colorimetric detector tubes must be used according to the manufacturer's instructions; and
- (5) If the carbon adsorber's exhaust exceeds 25 ppm then the desorption cycle shall be adjusted or the carbon canister replaced in order to bring the exhaust concentration below 25 ppm; and
- (6) If desorption of the carbon adsorber is required, the carbon adsorber shall not be bypassed during the desorption cycle.

36.9.6 If dwell or a superheated vapor system is used, the actual dwell time shall not exceed the minimum dwell time. Minimum and actual dwell time shall be determined using the following procedures:

- (a) For units without a superheated vapor system, the minimum dwell time shall be determined for each part type or parts basket or for the most complex part type or parts basket using the following procedure:
  - (1) Determine the amount of time necessary for the part or parts basket to cease dripping once placed in the vapor zone. The part or parts basket used for this determination must be at room temperature when placed in the vapor zone; and
  - (2) The minimum dwell time required for parts to remain in the freeboard zone above the vapor zone is calculated as 35 percent of the time determined in Paragraph (a)(1) of this subsection.
- (b) The minimum dwell time for a cleaning machine equipped with a superheated vapor system shall be determined according to the specifications of the manufacturer of the control equipment; and

- (c) On a monthly basis, the actual dwell time that parts are held in the freeboard zone above the vapor zone shall be measured; and
- (d) If the actual dwell time is less than the minimum dwell time determined using the applicable procedure in Paragraph (a) or (b) of this subsection for a particular part or parts basket, the automatic parts handling system must be adjusted so that this specification is met.

36.9.7 Safety switches must be tested semiannually.

36.9.8 Alternative monitoring procedures may be used if approved by the Director and the EPA.

### **36.10 Recordkeeping**

36.10.1 The owner or operator of a batch vapor or in-line organic cleaning machine shall maintain the following records for the lifetime of the cleaning unit:

- (a) Owner's manuals or written maintenance and operating procedures for the cleaning machine and air pollution control equipment; and
- (b) Date of installation of the cleaning machine and its control devices; and
- (c) Records of the content of each solvent used in the cleaning machine; and
- (d) If dwell or superheated vapor is used, the minimum dwell times determined using the procedures specified in Paragraph (a) or (b) of Subsection 36.9.6; and
- (e) Records of training provided to solvent cleaning machine operators.

36.10.2 The owner or operator of a batch vapor or in-line organic cleaning machine shall maintain the following records for a period of five years:

- (a) Amount and type of solvent used in each cleaning machine each year; and
- (b). Amount of trichloroethylene, perchloroethylene and methylene chloride used in each cleaning machine each month; and
- (c) Results of monitoring required under Section 36.9; and

- (d) Information on the actions taken to comply with Subsections 36.9.2(c), 36.9.3(c), 36.9.4(c), 36.9.5(b)(5), and 36.9.6(d). This includes records of written or verbal orders for replacement parts, a description of the repairs made, and the additional monitoring conducted to demonstrate that monitored parameters have returned to acceptable levels; and
- (e) The dates that carbon adsorber beds are desorbed; and
- (f) The dates that the carbon adsorber bed is changed; and
- (g) The date and type of each equipment malfunction (or leak) and the date it is repaired; and
- (h) The date and time of each incidence where a cover was not in place, as specified in 36.6.1 and 36.7.1; and
- (i) If any safety switches are activated, the date and the reason why the switch was triggered;
- (j) The results of semiannual safety switch tests; and
- (k) For batch vapor machines which have been exempted from the automated parts handling system requirements of Subsection 36.6.3, a log of additions and deletions of solvent from the exempted vapor cleaning machine, as required in Subsection 36.12.4.

36.10.3 The owner or operator of a batch vapor cleaning machine without a solvent/air interface complying with the emission limits in Section 36.8 must maintain the following records for five years:

- (a) A log of solvent additions and deletions, as required in Subsection 36.8.1; and
- (b) Monthly emissions, average monthly emissions for each 3 month period, and the calculations of those values according to the procedure specified in Subsection 36.8.3; and
- (c) The amount of solvent in the solid waste removed from the cleaning machine, calculated using the procedure specified in Subsection 36.8.3(d); and
- (d) The method used to determine the cleaning capacity of the cleaning machine.

36.10.4 The owner or operator of a batch cold cleaning machine shall maintain records of training provided to cleaning machine operators for the lifetime of the unit and shall maintain the following records for a period of five years:

- (a) Amount and type of solvent used in each cleaning machine each year and
- (b) The date and type of each equipment malfunction (or leak) and the date it is repaired.
- (c) The date and time of each incidence where a cover was not in place, as specified in 36.5.1. and
- (d) The amount of trichloroethylene, perchloroethylene and methylene chloride used in each cleaning machine each month.

36.10.5 The owner or operator of a cold cleaning machine shall maintain, for a period of not less than two years, written records of each purchase of solvents containing volatile organic compounds for cold cleaning, including the following information:

- (a) The name and address of the solvent supplier.
- (b) The type of solvent, including the product or vendor identification number.
- (c) The vapor pressure of the solvent measured in mm Hg at 20°C (68°F)
- (d) An invoice, bill of sale, certificate that corresponds to a number of sales, Material Safety Data Sheet (MSDS), or other documentation acceptable to the Department may be used to comply with this Subsection.

36.10.6 All records specified in Subsections 36.10.1 through 36.10.5 shall be made available to the Department or the EPA for inspection upon request.

## **36.11 Reporting Requirements**

### **36.11.1 Initial Notification Report**

- (a) The owner or operator of an organic solvent cleaning machine installed before November 29, 1993 that uses a solvent containing trichloroethylene, perchloroethylene, 1,1,1-trichloroethane, methylene chloride, chloroform, or carbon tetrachloride must

submit an Initial Notification Report to the Division no later than August 29, 1995. This report must include the following information:

- (1) The name and address of owner or operator; and
  - (2) The address of the solvent cleaning machine(s); and
  - (3) The type of the solvent cleaning machine (cold, batch vapor, or in-line), the area of the solvent/air interface, and the type of existing controls; and
  - (4) The date of installation of the solvent cleaning machine(s) and related control devices. If the dates of installation are not known a letter certifying that installation was prior to, or after, November 29, 1993 is acceptable; and
  - (5) The anticipated compliance approach for each solvent degreaser; and
  - (6) An estimate of the amount of solvent used annually in each solvent cleaning machine.
- (b) The owner or operator of an organic solvent cleaning machine installed on or after November 29, 1993 that uses a solvent containing trichloroethylene, perchloroethylene, 1,1,1-trichloroethane, methylene chloride, chloroform, or carbon tetrachloride must submit an Initial Notification Report to the Division 120 days before startup of the cleaning machine or by January 31, 1995, whichever is later. This report must include the following information:
- (1) The name and address of owner or operator; and
  - (2) The address of the solvent cleaning machine(s); and
  - (3) The type of solvent cleaning machine (cold, batch vapor, or in-line), the solvent/air interface area, and the type of existing controls; and
  - (4) The facility's anticipated compliance approach for each solvent cleaning machine; and
  - (5) The expected commencement date of the construction or reconstruction; and

- (6) The expected completion date of the construction or reconstruction; and
  - (7) The anticipated date of startup of the solvent cleaning machine; and
  - (8) An estimate of the amount of solvent which will be used annually in each solvent cleaning machine.
- (c) The owner or operator of an organic solvent cleaning machine that uses a solvent containing trans 1,2-dichloroethene or n-propyl bromide must submit an Initial Notification Report to the Office of Air Resources one hundred and twenty (120) days before startup of the cleaning machine using that solvent or by January 9, 2009, whichever is later. This report must include the following information:
- (1) The name and address of the owner or operator; and
  - (2) The address of the solvent cleaning machine(s); and
  - (3) The type of solvent cleaning machine used (cold, batch vapor, or in-line), the solvent/air interface area, and the type of controls used; and
  - (4) The facility's anticipated compliance approach and the anticipated date of compliance for each solvent cleaning machine; and
  - (5) An estimate of the amount of solvent to be used annually in each solvent cleaning machine.

#### 36.11.2 Compliance Notification Report

- (a) The owner or operator of an organic solvent cleaning machine installed before November 29, 1993 must submit a Compliance Notification Report to the Division of Air Resources no later than March 1, 1997. Compliance Notification Reports for organic solvent cleaning machines installed on or after November 29, 1993 must be submitted no more than 60 days after startup of the cleaning machine or by June 7, 1996, whichever is later.
- (b) The owner or operator of an organic solvent cleaning machine that uses a solvent containing trans 1,2-dichloroethene or n-propyl bromide must submit a Compliance Notification Report to the Office of Air Resources no later than April 9, 2009 or no more

than thirty (30) days after startup of the cleaning machine using that solvent, whichever is later

- (c) Compliance Notification Reports shall contain the following information:
  - (1) The name and address of the owner or operator; and
  - (2) The address of the solvent cleaning machine; and
  - (3) A statement, signed by the owner or operator, stating that each cleaning machine is in compliance with this regulation; and
  - (4) The control equipment used to achieve compliance for each cleaning machine; and
  - (5) If a refrigerated freeboard chiller or superheated vapor is used, the dates and results of weekly temperature monitoring for the first month after the compliance date; and
  - (6) If a carbon adsorber is used, the date and results of weekly measurements of the solvent concentration in the exhaust for the first month after the compliance date; and
  - (7) If dwell is used, the minimum dwell times and the actual dwell times measured for the first month; and
  - (8) For vapor cleaning machines without solvent/air interfaces, a description of the method used to determine the cleaning capacity of the machine and the results of the monthly solvent emissions calculation for the month beginning with the compliance date.

### 36.11.3 Exceedances and Exceedance Reports

- (a) The following occurrences are considered exceedances and must be reported on the facility's Exceedance Report:
  - (1) An exceedance has occurred if the requirement in Subsection 36.9.5(b)(6) has not been met; or



- (2) An exceedance has occurred if the requirements in Subsections 36.9.1, 36.9.2, 36.9.3, 36.9.4, 36.9.5 or 36.9.6 are not met. Once adjustments or repairs have been made, parameters must be remeasured to demonstrate that the parameter is within the acceptable limits; or
  - (3) If a vapor cleaning machine does not have a solvent/air interface, an exceedance has occurred if the three month average monthly emission limit is not met in any month;
  - (4) If a vapor cleaning machine has been exempted from the automated parts handling system requirements, an exceedance has occurred if the three month emission limit, S, as calculated using Equation 4, is not met in any month.
  - (5) An exceedance has occurred if emissions exceed the facility wide emission limits specified in 40 CFR Part 63.471.
- (b) The owner or operator of a batch vapor or in-line cleaning machine shall initially submit Exceedance Reports semiannually, except when the Department determines on a case-by-case basis that more or less frequent reporting is necessary.
  - (c) If an exceedance occurs, Exceedance Reports must be submitted quarterly until a request to reduce the reporting frequency as specified in Subsection 36.11.3 (f) has been approved.
  - (d) The Exceedance Report shall be received by the thirtieth day following the end of each exceedance reporting period. Initial reporting periods are January 1 - June 30 and July 1 - December 31.
  - (e) Exceedance Reports shall include the following information for actions taken to comply with Subsections 36.9.1, 36.9.2, 36.9.3, 36.9.4, 36.9.5, or 36.9.6:
    - (1) Records of written or verbal orders for replacement parts, a description of the repairs made, additional monitoring to demonstrate that monitored parameters have returned to acceptable levels; and
    - (2) If an exceedance has occurred, the reason for the exceedance and a description of the actions taken to correct the exceedance; and

- (3) If an exceedance has occurred, the dates the cleaning machine or control equipment was repaired, retested, and returned to service; and
  - (4) If an exceedance has not occurred or the cleaning and control equipment has not been inoperative, repaired, or adjusted, this information must be stated in the report.
- (f) If a facility is required to submit Exceedance Reports on a quarterly (or more frequent) basis, the submittal frequency may be reduced to semiannual with the Director's approval, if the following requirements are achieved:
- (1) The facility has demonstrated a full year of compliance without an exceedance; and
  - (2) The owner or operator continues to comply with the recordkeeping and monitoring requirements specified in this regulation.

#### 36.11.4 Annual Compliance Reports

- (a) The owner or operator of a batch vapor or in-line solvent cleaning machine shall submit an annual report to the Office of Air Resources by February 1 of each year for the previous calendar year. This report shall include the following:
- (1) A signed statement from the facility owner or his designee stating that, "All operators of solvent cleaning machines have received training on the proper operation of solvent cleaning machines and their control devices sufficient to pass the test required in Appendix A."
  - (2) An estimate of solvent consumption for each solvent cleaning machine during the reporting period.
  - (3) For each machine complying with Section 36.8, the average monthly solvent consumption and the average monthly emissions for each consecutive three month period, calculated using Equation 3.
  - (4) For each batch vapor cleaning machine that has received an exemption from the automated parts handling system requirements, as specified in Section 36.12, the solvent

emissions during each three month period, calculated using Equation 5.

- (b) The owner or operator of a facility which uses a solvent containing trichloroethylene, perchloroethylene or methylene chloride in a solvent cleaning machine shall report its annual emissions of those solvents in writing to the Office of Air Resources on or before 15 April of the following calendar year. The report shall be signed by the owner or operator of the facility and can be fulfilled by submitting the reports required in Rhode Island Air Pollution Control Regulation No. 14, sections 14.2 and 14.3. If annual emissions of those solvents from solvent cleaning operations at a facility exceed 50% of the facility wide limits established in 40 CFR 63.471 in any year, the facility must thereafter fulfill all applicable recordkeeping and reporting requirements in 40 CFR 63.460 and 40 CFR 63.471.

**36.12 Exemption from Automated Parts Handling System Requirement**

36.12.1 The owner or operator of a batch vapor cleaning machine may apply for an exemption from the automated parts handling system requirement in Subsection 36.6.3. Exemptions shall limit solvent emissions from the cleaning machine during any three month period after the compliance date to the amount calculated using Equation 4:

$$S = 92 * A \qquad \text{Equation 4}$$

Where:

S = The amount of solvent, in pounds, that can be emitted from that cleaning machine during any three month period after the compliance date specified in Section 36.3

A = The area of the solvent/air interface for that machine, in square feet.

36.12.2 Exemption requests shall be submitted to the Division by the following dates:

- (a) December 1, 1996 for vapor cleaning machines that commenced construction or reconstruction before November 29, 1993, and
- (b) 30 days prior to startup or May 8, 1996, whichever is later, for vapor cleaning machines that commenced construction or reconstruction on or after November 29, 1993.

36.12.3 Exemption requests shall include the following information:

- (a) The name and address of the facility; and
- (b) An identification of the vapor cleaning machine for which the exemption is being requested; and
- (c) The area of the solvent/vapor interface, in square feet, of the vapor cleaning machine; and
- (d) The three month emission limit, S, calculated using Equation 4; and
- (e) A statement, signed by the owner or operator of the facility, that emissions of solvent from the vapor cleaning machine will not exceed the three month emission limit, S, during any three month period after the compliance date in Section 36.3.

36.12.4 The owner or operator of a facility which is granted an exemption to the requirements of Subsection 36.6.3 shall maintain a log of additions and deletions of solvent from the exempted vapor cleaning machine.

36.12.5 The owner or operator of a facility which is granted an exemption to the requirements of Subsection 36.6.3 shall demonstrate compliance with the three month emission limit, S, calculated using Equation 4 on the first operating day of every month using the following procedure:

- (a) A fill-line must be marked on the machine on the first month the measurements are taken; and
- (b) On the first day of each month thereafter, the machine shall be filled to the fill-line with clean liquid solvent; and
- (c) On the first day of each month, using the log of solvent additions and deletions required in Subsection 36.12.4, calculate solvent emissions for the most recent three month period with Equation 5:

$$EA = SA - SR \qquad \text{Equation 5}$$

Where:

EA = solvent emissions during the three month period (pounds)

SA = the total amount of solvent added to the cleaning machine during the three month period (pounds)

SR = the total amount of solvent removed from the cleaning machine during the three month period (pounds)

- (d) The cleaning machine is in compliance with the three month emission limit if solvent emissions in the three month period, EA, calculated using Equation 5, are less than or equal to S, calculated according to Equation 4.

36.12.6 If the three month emission limit, S, is exceeded two times, an automated parts handling system must be installed within 60 days of the end of the three month period in which the second exceedance occurred.

### **36.13 General Provisions**

#### 36.13.1 Purpose

The purpose of this regulation is to limit emissions from organic solvent cleaning operations.

#### 36.13.2 Authority

These regulations are authorized pursuant to R.I. Gen. Laws § 42-17.1-2(s) and 23-23, as amended, and have been promulgated pursuant to the procedures set forth in the R.I. Administrative Procedures Act, R.I. Gen. Laws Chapter 42-35

#### 36.13.3 Application

The terms and provisions of this regulation shall be liberally construed to permit the Department to effectuate the purposes of state law, goals and policies.

#### 36.13.4 Severability

If any provision of this regulation or the application thereof to any person or circumstance, is held invalid by a court of competent jurisdiction, the validity of the remainder of the regulation shall not be affected thereby.

#### 36.13.5 Effective Date

The foregoing regulation, "Control of Emissions from Organic Solvent Cleaning", as amended, after due notice, is hereby adopted and filed with the Secretary of State this 19th day of September, 2008 to become effective twenty (20) days thereafter, in accordance with the provisions of Chapters 23-23, 42-35, 42-17.1, 42-17.6, of the General Laws of Rhode Island of 1956, as amended.

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W. Michael Sullivan, PhD., Director  
Department of Environmental Management

**Notice Given on: July 8, 2008**

**Public Hearing held: August 8, 2008**

**Filing Date: September 19, 2008**

**Effective Date: October 9, 2008**

## Appendix A

### Test of Operator Knowledge of Solvent Cleaning Procedures

#### General Questions

1. What is the maximum allowable speed for parts entry and removal?
  - A. 28 feet per minute
  - B. 10 feet per minute
  - C. 36 feet per minute
  - D. No limit
  
2. How do you ensure that parts enter and exit the solvent cleaning machine at the speed required in the regulation?
  - A. Program on computerized hoist monitors speed.
  - B. Can judge the speed by looking at it.
  - C. Measure the time it takes the parts to travel a measured distance.
  
3. Identify the sources of air disturbances?
  - A. Fans
  - B. Open doors
  - C. Open windows
  - D. Ventilation vents
  - E. All of the above
  
4. What are the three operating modes?
  - A. Idling, working, and downtime
  - B. Precleaning, cleaning, and drying
  - C. Startup, shutdown, off
  - D. None of the above
  
5. When can parts or parts baskets be removed from the solvent cleaning machine?
  - A. When they are clean
  - B. At any time
  - C. When dripping stops
  - D. Either A or C is correct
  
6. How must parts be oriented during cleaning?
  - A. It does not matter as long as they fit in the parts basket.
  - B. So that the solvent pools in the cavities where the dirt is concentrated.
  - C. So that solvent drains from them freely.
  
7. During startup, what must be turned on first, the primary condenser or the sump heater?
  - A. Primary condenser
  - B. Sump heater

- C. Turn both on at same time
  - D. Either A or B is correct
8. During shutdown, what must be turned off first, the primary condenser or the sump heater?
- A. Primary condenser
  - B. Sump heater
  - C. Turn both on at same time
  - D. Either A or B is correct
9. In what manner must solvent be added to and removed from the solvent cleaning machine?
- A. With leak proof couplings
  - B. With the end of the pipe in the solvent sump below the liquid solvent surface.
  - C. So long as the solvent does not spill, the method does not matter.
  - D. A and B
10. What must be done with waste solvent, still bottoms, and sump bottoms?
- A. Pour down the drain
  - B. Store in closed container
  - C. Store in a bucket
  - D. A or B
11. What types of materials are prohibited from being cleaned in solvent cleaning machines using halogenated HAP solvents?
- A. Sponges
  - B. Fabrics
  - C. Paper
  - D. All of the above
12. When can a cover be open?
- A. While parts are in the cleaning machine
  - B. During parts entry and removal or when an in-line conveyor is operating
  - C. At all times
  - D. Never
13. Covers must be maintained in what condition?
- A. Free of holes
  - B. Free of cracks
  - C. So that they completely seal cleaning opening
  - D. All of the above

#### Control Device Specific Questions

#### **Freeboard Refrigerated Chiller**



1. What temperature must the freeboard refrigerated chiller achieve?
  - A. Below room temperature
  - B. 50°F
  - C. Below the solvent boiling point
  - D. 30 percent of the solvent's boiling point

**Dwell**

2. Where must the parts be held for the appropriate dwell time?
  - A. In the vapor zone
  - B. In the freeboard zone above the vapor zone
  - C. Above the cleaning machine
  - D. In the immersion sump

## Answers

### General Questions

1. B
2. A or C
3. E
4. A
5. C
6. C
7. A
8. B
9. D
10. B
11. D
12. B
13. D

### Control Device Specific Questions

1. D
2. B