

EPA-453/P-06-001 (August 1, 2006)

**Control Techniques Guidelines:
Industrial Cleaning Solvents
(DRAFT)**

**U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Sector Policy and Programs Division
Research Triangle Park, NC 27711**

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I. Introduction

Clean Air Act (CAA) section 172(c)(1) provides that state implementation plans (SIPs) for nonattainment areas must include “reasonably available control measures” (RACM), including “reasonably available control technology” (RACT), for sources of emissions. Section 182(b)(2) provides that for certain nonattainment areas, States must revise their SIPs to include RACT for sources of VOC emissions covered by a control techniques guidelines (CTG) document issued after November 15, 1990 and prior to the area’s date of attainment.

The United States Environmental Protection Agency (EPA) defines RACT as “the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility.” 44 FR 53761 (Sept. 17, 1979). In subsequent Federal Register notices, EPA has addressed how states can meet the RACT requirements of the Act.

CAA section 183(e) directs EPA to list for regulation those categories of products that account for at least 80 percent of the VOC emissions, on a reactivity-adjusted basis, from consumer and commercial products in areas that violate the NAAQS for ozone (i.e., ozone nonattainment areas). EPA issued the list on March 23, 1995, and has revised the list periodically. *See* 60 FR 15264 (March 23, 1995); *see also* 71 FR 28320 (May 16, 2006), 70 FR 69759 (Nov. 17, 2005); 64 FR 13422 (Mar. 18, 1999). Industrial cleaning solvents are included on the current section 183(e) list.

This draft CTG is intended to provide state and local air pollution control authorities information that should assist them in determining RACT for volatile organic compounds (VOCs) for industrial cleaning solvents. In developing this CTG, EPA, among other things, evaluated the sources of VOC emissions from the use of industrial cleaning solvents and the available control approaches for addressing these emissions, including the costs of such approaches. Based on available information and data, EPA provides recommendations for RACT for industrial cleaning solvents. EPA solicits comment on all aspects of this draft document.

Once finalized, States can use the recommendations in this CTG to inform their own determination as to what constitutes RACT for VOC for industrial cleaning solvents in their particular nonattainment areas. The information contained in this document is provided only as guidance. This guidance does not change, or substitute for, applicable sections of the CAA or EPA’s regulations; nor is it a regulation itself. This document does not impose any legally binding requirements on any entity. It provides only recommendations for state and local air pollution control agencies to consider in determining RACT. State and local pollution control agencies are free to implement other technically-sound approaches that are consistent with the CAA and EPA’s implementing regulations

The recommendations contained in this draft CTG are based on the data and information currently available to EPA. These general recommendations may not apply to a particular situation based upon the circumstances. Regardless of whether a State chooses to implement the recommendations contained herein through State rules, or to issue State rules that adopt different approaches for RACT for VOCs from industrial cleaning solvents, States must submit their RACT rules to EPA for review and approval as part of the SIP process. EPA will evaluate the rules and determine, through notice and comment rulemaking in the SIP process, whether they meet the RACT requirements of the Act and EPA's regulations. To the extent a State adopts any of the recommendations in this guidance into its State RACT rules, interested parties can raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance to a particular situation during the development of the State rules and EPA's SIP approval process.

CAA section 182(b)(2) provides that a CTG issued after November 15, 1990 and before the date of attainment must include the date by which States must submit SIP revisions in response to the CTG. States subject to section 182(b) should submit their SIP revisions within one year of the date of issuance of the final CTG for industrial cleaning solvents. States subject to CAA section 172(c)(1) may take action in response to this guidance, as necessary to attain.

The remainder of this document is divided into six sections. Section II provides the Background and Overview, which lists the cleaning (unit) operations associated with industrial cleaning solvents and identifies the sources of VOC emissions from those cleaning operations. Section III describes the emissions threshold that applies to this draft CTG. Section IV describes the available control options for addressing VOC emissions and summarizes state and local regulatory approaches for addressing such emissions. It also lists categories of industries for exclusion from the draft CTG. (A summary of the state and local regulatory approaches that EPA surveyed in preparing this draft document will be placed in the docket in the form of a memo. This information supplements the survey of state CTG summarize in Appendix B of the 1994 ACT). The fourth section provides our proposed recommendations for RACT for industrial cleaning solvents. Section V discusses the cost-effectiveness of the recommended controls. Section VI provides a list of references.

II. Background and Overview

This category of consumer and commercial products includes the industrial cleaning solvents used by many industries. It includes a variety of products that are used to remove contaminants such as adhesives, inks, paint, dirt, soil, oil, and grease. Contaminants are removed from parts, products, tools, machinery, equipment, vessels, floors, walls, and other work production related work areas for a variety of reasons including safety, operability, and to avoid product contamination. The cleaning solvents used in these (unit) operations are, in many cases, generally available bulk solvents that are used for a multitude of applications not limited to cleaning. For example, petroleum distillates may be used as a cleaning solvent, as a paint thinner, or as an ingredient used

in the manufacture of a coating, such as paint. Because a portion of all solvents evaporate during use, such solvent-based cleaning materials result in large amounts of emissions of VOC.

In 1994, EPA completed a study of industrial cleaning solvents that characterized cleaning operations carried out within six focus industries (automotive, electrical equipment, magnetic tape, furniture, packaging, and photographic supplies) to evaluate sources of evaporative emissions from VOC solvents used as cleaning materials. (See Reference 1 in the reference section for the citation to this document). We believe that the range of cleaning activities performed in these focus industries provide a good variety of cleaning operations for the study, and that the information obtained relevant to VOC emission sources and possible control techniques can be applied to virtually any industry.

Data collected by EPA during the development of the 1994 Alternative Control Techniques (ACT) (to be referred to as 1994 ACT or ACT) document for industrial cleaning solvents show nationwide usage of VOC solvent from six industries studied is more than 360,000 Mg/yr (400,000 tpy).¹ We also reported in the ACT document that the estimated total VOC solvent usage for cleaning by all U.S. industry was more than 910,000 Mg/yr (1 million tpy). This number was estimated using multiple sources, including data from the facilities we surveyed. In general, VOC emissions occur from industrial cleaning solvents through evaporation during cleaning activities such as wiping, flushing, and brushing, as well as from storage and disposal of used shop towels and solvent.

The 1994 ACT is included as Appendix A to this draft CTG. The document provides a thorough discussion of cleaning activities and types of cleaning operations in a wide and diverse assortment of industrial facilities, frequently used cleaning solvents, and the practices (or lack of) for managing solvents. It, also, identifies a methodology for estimating VOC emissions by cleaning operation, discusses control techniques for addressing such emissions, the costs-benefits of setting up a solvent accounting and management system, and other items.

EPA surveyed 34 facilities in the six focus industries and collected approximately 300 individual cleaning data sets or unit operation systems (UOS) representing emissions from the nine types of cleaning unit operations (UO) in the focus industries for the ACT document. These nine UO are identified below together with the VOC emission distribution based on the UOS material balance data:

- Spray Gun Cleaning (50 percent)
- Spray Booth Cleaning (14 percent)
- Large Manufactured Components Cleaning (14 percent)
- Parts Cleaning (7.0 percent)
- Equipment Cleaning (6.9 percent)
- Line Cleaning (3.6 percent)
- Floor Cleaning (2.9 percent)
- Tank Cleaning (0.82 percent)

- Small Manufactured Components Cleaning (0.44 percent).

Because spray gun cleaning (one of the UO) accounted for 50 percent of the emissions from cleaning operations, the ACT dedicated appendix G of the document to describe procedures for determining, in a consistent way, VOC emissions from a number of subcategories of spray gun cleaning. The subcategories represented the range of gun cleaning practices in the focus industries in 1994. However, due to the availability of enclosed gun cleaners today, states have disallowed gun cleaning methods that result in high solvent emissions.

The purpose of identifying these UO is to assist State and local agencies in identifying the sources of VOC emissions from cleaning activities and to provide a structure for developing and applying control techniques to mitigate VOC emissions from industrial cleaning solvents used in these UO. And from this study, EPA believes all categories of industrial cleaning operations are represented.

The ACT document provided a quantitative overview of cleaning solvents used and a model for accounting and tracking solvent usage--a solvent management system. It also provided a methodology for calculating emissions in a consistent way.

Although the industrial cleaning solvent product category includes a variety of different products with differing VOC contents, and although these products are used in different ways by a wide range of industries, we believe that there are two basic approaches to achieve VOC emission reductions from this product category. First, the users of the products can control emissions through work practices targeted at the activities and sources of emissions specific to the user's industry (e.g., keeping solvent containers covered, properly storing and disposing of used shop towels and solvent, etc.). Second, users can reduce overall VOC emissions through solvent substitution (e.g., use of low-VOC, no-VOC, or low-vapor pressure solvents). These two general approaches are effective strategies to achieve significant emission reductions from this product category, notwithstanding the variation in the products, their users, and their specific uses.

We are considering including an example rule when we finalize this draft CTG that would incorporate the recommendations contained in the final CTG. We solicit comments on the utility of such an example rule in the final CTG.

III. Applicability (Scope of Sources)

In the draft CTG, EPA recommends that, in general, the recommendations in this CTG should have broad applicability to any industrial cleaning operations that have VOC emissions of at least 6.8 kg/day (15 lb/day), before controls. This level of emissions has been the applicability threshold for many CTGs in the past. Furthermore, it is consistent with the intent of CAA section 183(e) to address individually small uses of consumer and commercial products that, in the aggregate, are significant sources of VOC emissions. We recommend that, for purposes of determining this threshold, aggregate emissions from all solvent cleaning activities associated with covered operations at a

given facility are included. As described below, we also recommend that specific industry category exclusions, similar to the ones provided for in the Bay Area and South Coast rules but tailored to the States' individual situations, accompany the applicability threshold.

In addition to the exclusions a State or local agency may specify as a result of the existence of effective measures that address cleaning operations associated with specific source categories within its jurisdiction, we recommend that the States exclude from applicability those cleaning operations in the following categories listed for regulation under CAA section 183(e): aerospace coatings, wood furniture coatings, shipbuilding and repair coatings, flexible packaging printing materials, lithographic printing materials, letterpress printing materials, flat wood paneling coatings, large appliance coatings, metal furniture coatings, paper film and foil coating, plastic parts coatings, miscellaneous metals parts coatings, fiberglass boat manufacturing materials, miscellaneous industrial adhesives, and auto and light-duty truck assembly coatings. For three of these product categories (i.e., aerospace coatings, wood furniture coatings, and shipbuilding and repair coatings), EPA has already issued CTGs that address cleaning operations. For the remaining categories, EPA intends to include control measures for cleaning associated with these categories if the Agency determines that a CTG is appropriate for the respective categories.

We estimate that there are approximately 7360 facilities in nonattainment areas for 8-hour ozone standards of which about 2550 would be potentially affected because they meet the 6.8 kg/day (15 lb of VOC /day) applicability threshold for this draft CTG. We derived these number based on available information concerning the use of industrial cleaning solvents from the 2002 EPA National Emissions Inventory.

IV. Recommended Control Options

The recommended measures for controlling emissions of VOC from the use, storage, and disposal of industrial cleaning solvents includes work practices, limitations on VOC content of the cleaning materials, and an optional alternative limit on composite vapor pressure of the cleaning materials. The first two recommendations are based on the Bay Area AQMD rule. Following the recommended control measures section is a discussion of recommended exclusions from applicability of these measures that should be considered by the State and local agencies.

When developing RACT measures for industrial cleaning operations, we suggest that State and local agencies consider the specific industries and operations in their jurisdictions and the individual requirements of those operations and tailor their rules to those specific scenarios accordingly. Furthermore, in considering existing cleaning requirements as bases for specific exemptions from their general industrial cleaning solvents rules, State and local agencies should take into account how current those measures are. EPA believes that more recent rules are likely to be more effective than older, possibly outdated, rules. We remind States that the determination of whether a specific State or local measure meets the RACT requirements of the Act will occur

during the notice and comment rulemaking process associated with EPA action on SIP submissions.

A. Control Measures

1. Work Practices

Recommended work practices that will help reduce VOC emissions from the use, handling, storage, and disposal of cleaning solvents and shop towels include:

- Covering open containers and used applicators;
- Minimizing air circulation around cleaning operations;
- Properly disposing of used solvent and shop towels; and
- Implementing equipment practices that minimize emissions (e.g., keeping parts cleaners covered, maintaining cleaning equipment to repair solvent leaks, etc.).

2. VOC Content Limit

We recommend a generally applicable VOC content limit of 50 grams VOC per liter (0.42 lb/gal) of cleaning material for each of the nine cleaning UO identified in the Background and Overview section, unless emissions are controlled by an emission control system with an overall control efficiency of at least 85 percent. This limit is modeled on the “general use” category of the Bay Area AQMD solvent cleaning regulations, taking into account the specific exclusions provided for in the Bay Area AQMD rule and described below.

3. Alternative Composite Vapor Pressure Limit

In addition to the recommended VOC content limit, EPA is considering possible inclusion of a composite vapor pressure limit of 8 millimeters of mercury (mmHg) at 20 degrees Celsius, as (1) a replacement for the 50 g/l VOC content limit entirely; or (2) an alternative limit that may be used in lieu of the 50 g/l VOC content limit for specific operations as determined by the State or local agency. We recommend that such a limit be considered for each of the nine cleaning UO identified in the Background and Overview section.

B. Exclusions

This section includes product categories that EPA has listed for regulation under section 183(e) as well as categories of cleaning operations that are specifically excluded from applicability in the Bay Area rule. The Bay Area exclusions are provided as examples for consideration by the State and local agencies.

1. Categories Listed for Regulation under CAA Section 183(e)

We recommend that the States exclude from applicability those cleaning operations in the following categories listed for regulation under CAA section 183(e):

- Aerospace coatings
 - Wood furniture coatings
 - Shipbuilding and repair coatings
 - Flexible packaging printing materials
 - Lithographic printing materials
 - Letterpress printing materials
 - Flat wood paneling coatings
 - Large appliance coatings
 - Metal furniture coatings
 - Paper film and foil coating
 - Plastic parts coatings
 - Miscellaneous metals parts coatings
 - Fiberglass boat manufacturing materials
 - Miscellaneous industrial adhesives
 - Auto and light-duty truck assembly coatings
2. Categories with Specific Exemptions under Bay Area 8-4-116
- Electrical and electronic components
 - Precision optics
 - Numismatic dies
 - Stripping of cured inks, coatings, and adhesives
 - Cleaning of resin, coating, ink, and adhesive mixing, molding, and application equipment
 - Research and development laboratories
 - Medical device or pharmaceutical manufacturing
 - Performance or quality assurance testing of coatings, inks, or adhesives
3. Categories Subject to Specific Rules and Exemptions under Bay Area 8-4-117
- Architectural coating
 - Metal container, closure, and coil coating
 - Paper, fabric, and film coating
 - Light and medium duty motor vehicle assembly plants
 - Surface coating of metal furniture and large appliances
 - Surface coating of miscellaneous metal parts and products
 - Graphic arts printing and coating operations
 - Coating of flat wood paneling and wood flat stock
 - Magnet wire coating operations

- Aerospace assembly and component coating operations
- Semiconductor wafer fabrication operations
- Surface coating of plastic parts and products
- Wood products coating
- Coating, ink, and adhesive manufacturing
- Flexible and rigid disc manufacturing
- Marine vessel coating
- Motor vehicle and mobile equipment coating operations
- Polyester resin operations

4. Categories with special limits in South Coast AQMD Rule 1171(c) and exemptions in 1171(h)

In addition to the Bay Area exclusions, and as discussed earlier, the more stringent South Coast AQMD “general use” limit of 25 g/l (0.21 lb/gal) is accompanied by higher limits for several individual operations. Although we are not recommending higher limits for these categories beyond the 50 g/l limit in this CTG, State and local agencies should be aware of the individual performance requirements in these categories when developing individual State or local cleaning solvent rules based on the specific industries within their jurisdictions. We suggest that State and local agencies refer to the South Coast rule for more details on subcategories and specific limits. The broad categories are:

- Product cleaning during manufacturing process or surface preparation for coating
- Repair and maintenance cleaning
- Cleaning of coatings or adhesives application equipment
- Cleaning of ink application equipment
- Cleaning of polyester resin application equipment

V. Impacts of Recommended Controls

EPA estimates that there are approximately 2,550 facilities in ozone nonattainment areas that would be affected by the draft CTG. These facilities had emissions that exceed the emission threshold of 6.8 kg (15 lb) of VOC per day. Total aggregate VOC emissions from solvent cleaning operations from these nonattainment sources are approximately 64,000 Mg/yr (71,000 tpy). EPA used studies published by the Bay Area AQMD to estimate the cost of compliance for the measures recommended in the draft CTG. According to these estimates, EPA believes that affected sources may either incur minimal additional costs or realize a savings on a case - by - case basis, depending primarily on facts such as how much they currently spend to operate high-VOC content solvent - based parts cleaners, and the cost of organic solvent disposal. The Bay Area AQMD studies indicate that there is a cost savings associated with replacing high-VOC cleaning materials with low-VOC, waterbased cleaning materials.

The total VOC emissions from solvent cleaning operations (64,000 Mg/yr (71,000 tpy) were determined by first assigning the VOC emissions from solvent cleaning operations at each facility (NEI database) to one of two general groups: parts cleaners, and other solvent cleaning operations. The parts cleaner subgroup included emissions from all SCC codes with a “degreasing” or cold solvent cleaning/stripping classification in SCC_L3. VOC emissions from this subcategory are approximately 4,000 Mg/yr (4,400 tpy). The other solvent cleaning operations included all other SCCs that were identified as solvent cleaning operations. The VOC emissions from the other subgroup are approximately 60,000 Mg/yr (66,000 tpy). These emissions do not include emissions from halogenated parts cleaners.

Costs associated with switchover to aqueous parts cleaners (cleaning systems or washers) include the initial cost of equipment, solvent costs, filters, electricity, and waste disposal costs. Many of these costs are also incurred when operating higher VOC solvent cleaners. A study on parts cleaners, for example, has shown typical annual costs for mineral spirits parts cleaners as \$1,453. Estimates on annual costs for aqueous parts cleaners, in comparison, range from \$1,171 to \$1,480, thus showing that facilities could either face a slight increase in cleaning costs or realize a cost savings as a result of the switchover.⁶

Facilities may either incur minimal additional costs or realize a savings on a case-by-case basis, depending primarily on how much they currently spend to operate the high VOC content solvent-based parts cleaners, the cost of organic solvent disposal, and air emission fees levied for VOC emissions. A study provided by the California Bay Area AQMD shows that the cost-effectiveness for meeting the 50 grams of VOC per liter of cleaning material limit for a parts cleaner is estimated at \$1,832/Mg (1,664/ton).^{6,7} This represents the annual cost of compliance (industry wide) for parts cleaners (Table 4 of the Bay Area Regulation 8, Rule 16). We determined that replacing high VOC content cleaning materials with low VOC water-based cleaning materials for the other cleaning (unit) operations (e.g., cleaning of large manufactured surfaces, tank cleaning, and gun cleaning, etc.) would result in an estimated cost savings of \$1,460/Mg. For this calculation we only considered the cost-difference in cleaning material cost and cost-difference in waste disposal cost. The savings is a result of the lower cost of aqueous cleaners which offset the increase in waste disposal cost for aqueous cleaners.

As explained above, this draft CTG is guidance for the States to use in determining RACT for VOC from industrial cleaning solvents. State and local pollution control agencies are free to implement other technically-sound approaches for RACT that are consistent with the CAA and EPA’s implementing regulations. Accordingly, there is necessarily some uncertainty in any prediction of costs and emission impacts associated with the recommendations in this document. Nevertheless, assuming that States adopt the recommendations in this draft CTG or comparable approaches, EPA anticipates a net cost savings. We based this prediction on an assumption that substitution of low-VOC materials for high-VOC materials is possible for all uses. Because this assumption is not true for some applications, this prediction may not be valid in all cases.

VI. References

1. U.S. Environmental Protection Agency, *Alternative Control Techniques Document—Industrial Cleaning Solvents*, February 1994. EPA-453/R-94-015. (NTIS PB 94-181-694).
2. Bay Area Air Quality Management District, Regulation 8, Rule 16: *Solvent Cleaning Operations*. [http:// www.arb.ca.gov/DRDB/BA/CURHTML/R8-16.PDF](http://www.arb.ca.gov/DRDB/BA/CURHTML/R8-16.PDF) , (Accessed June 27, 2006).
3. South Coast Air Quality Management District, Rule 1171: *Solvent Cleaning Operations*.
4. Sacramento Metropolitan Air Quality Management District, Rule 466: *Solvent Cleaning*.
5. U.S. Environmental Protection Agency, *Control of Volatile Organic Emissions from Solvent Metal Cleaning*, November 1977. EPA-450/2-77-022.
6. Bay Area Air Quality Management District, Staff Report: *Proposed Amendments to BAAQMD Regulation 8, Rule 16: Solvent Cleaning Operations*, September 2002.
7. South Coast Air Quality Management District, *Staff Report for Proposed Amendment to Rule 1171 - Solvent Cleaning Operations*, August 15, 1996.

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APPENDIX A

1994 Control Techniques Guidelines: Industrial Cleaning Solvents
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