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RTP, NC

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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). Offset lithographic printing and letterpress printing are included on the current section 183(e) list.

This CTG addresses both the offset lithographic printing industry and the letterpress printing industry. Although offset lithographic printing and letterpress printing are two distinct product categories on the section 183(e) list, they have many similarities in the types of inks and cleaning materials used, the sources of VOC emissions, and the controls available to address those emissions. We therefore address both categories in this CTG.

The 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 offset lithographic printing and letterpress printing. In developing this CTG, EPA, among other things, evaluated the sources of VOC emissions from these printing industries 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 offset lithographic printing and letterpress printing.

States can use the recommendations in this CTG to inform their own determination as to what constitutes RACT for VOCs for offset lithographic printing and letterpress printing 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 CTG are based on data and information currently available to EPA. These general recommendations may not apply to a particular situation based upon the circumstances of a specific source. 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 for offset lithographic printing and letterpress printing, 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 this final CTG. States subject to CAA section 172(c)(1) may take action in response to this guidance, as necessary to attain.

II. Background and Overview

On November 8, 1993, EPA published a draft CTG for offset lithographic printing. (58 FR 59261). After reviewing comments on the draft CTG and soliciting additional information to help clarify those comments, EPA published an alternative control techniques (ACT) document in June 1994 that provided supplemental information for States to use in developing rules based on RACT for offset lithographic printing. See References 1 and 2 in the reference section for the full citation to these documents.

The 1993 draft CTG and 1994 ACT (see Appendix A) provide a thorough discussion of the offset lithographic printing industry, the nature of VOC emissions from that industry, available control technologies for addressing such emissions, the costs of available control options, and other items. In large part, the recommended approaches for RACT in this document are similar to those proposed in 1993. EPA developed the recommended approaches contained in this document after reviewing existing state and local VOC emission reduction approaches, reviewing the 1993 draft CTG and 1994 ACT, and considering information obtained since issuance of the ACT.

As noted above, letterpress printing and offset lithographic printing have several important similarities, including similar sources of VOC emissions and similar available

VOC control approaches. In light of these similarities, EPA relied heavily on the substantial data and information included in the 1993 draft CTG and 1994 ACT for offset lithographic printing in formulating the recommendations for RACT in this document for the letterpress printing industry.

The remainder of this document is divided into seven sections. Section III describes the scope of sources to which this CTG applies. Section IV provides a summary of the processes associated with the offset lithographic printing and letterpress printing industries and identifies the sources of VOC emissions from those processes. Section V describes the available control approaches for addressing VOC emissions from this source category and summarizes state and local regulatory approaches for addressing such emissions. Section VI provides our recommendations for RACT for offset lithographic printing and letterpress printing. Section VII discusses the cost-effectiveness of the recommended control approaches. Section VIII presents factors to consider in assessing VOC emissions from offset lithographic printing and letterpress printing. References are provided in Section IX.

III. Applicability

This CTG provides control recommendations for reducing VOC emissions stemming from the use of fountain solutions, cleaning materials and inks in offset lithographic printing and cleaning materials and inks in letterpress printing. This section addresses EPA's recommendations as to the scope of entities to which the RACT recommendations in this CTG should apply. As explained above, this document is guidance and provides information for States to consider in determining RACT. When State and local pollution control agencies develop RACT rules, they may elect to adopt control approaches that differ from those described in this document and/or promulgate applicability criteria that differ from those recommended here.

In terms of applicability, we recommend that the control recommendations discussed in this CTG for cleaning materials and fountain solutions apply to any offset lithographic printing operation where the emissions associated with all aspects of that operation equal or exceed 6.8 kg/day (15 lb/day) actual emissions of VOC, or an equivalent level, before consideration of controls.[1] As noted below, the cleaning control approaches recommended in this CTG include limitations on the VOC composite vapor pressure of cleaning materials and limits on the VOC content of cleaning materials, with an exclusion of 110 gallons per year of cleaning materials which meet neither the low VOC composite vapor pressure recommendation nor the lower VOC content recommendation, and work practices. We further recommend that the recommendations concerning fountain solution, which are described in detail below, not be applied to sheet-fed presses with maximum sheet size 11x17 inches or smaller, or to any press with

[1] "Lithographic printing" means a printing process where the image and non-image areas are chemically differentiated; the image area is oil receptive and the non-image area is water receptive. This method differs from other printing methods, where the image is a raised or recessed surface. "Offset lithographic printing" means a printing process that transfers the ink film from the lithographic plate to an intermediary surface (blanket), which, in turn, transfers the ink film to the substrate.

total fountain solution reservoir of less than 1 gallon because for these presses. EPA recommends these exclusions because the recommended VOC (alcohol or alcohol substitute) content levels associated with such presses would yield a small emission reduction relative to the cost of achieving that reduction (e.g., changing and maintaining rollers).

Similarly, we recommend that the control approaches for cleaning materials discussed in this CTG apply to any letterpress printing operation where the emissions associated with all aspects of that operation equal or exceed 6.8 kg/day (15 lb/day) actual emissions of VOC, or an equivalent level, before consideration of controls.[2] As noted below, these control recommendations include limitations on the VOC composite vapor pressure of cleaning materials and limits on the VOC content of cleaning materials, with an exclusion of 110 gallons per year of cleaning materials which meet neither the low VOC composite vapor pressure recommendation nor the lower VOC content recommendation, and work practices.

In developing their RACT rules, State and local agencies should consider carefully the facts and circumstances of the affected sources in their States. As noted above, States can adopt the above recommended 15 lb/day actual emissions of VOC applicability criterion before consideration of controls, or an equivalent applicability level expressed on a monthly basis (e.g., 450 lb/month) or 12-month rolling basis (e.g., 3 tons per 12-month rolling period), or they can develop other applicability criteria that they determine are appropriate considering the facts and circumstances of the sources in their particular nonattainment areas. EPA will review the State RACT rules in the context of the SIP revision process.

The above recommended 15 lb/day threshold is consistent with the applicability threshold contained in many previous CTGs.[3] It is also consistent with the purpose of the section 183(e) program. In section 183(e), Congress directed EPA to assist States in achieving VOC emission reductions from consumer and commercial products. These products individually may result in relatively small amounts of VOC emissions, but, in the aggregate, they contribute significantly to ozone formation in nonattainment areas. Given the nature of the products and sources at issue here, we believe that the 15 lb/day actual VOC emissions before consideration of controls applicability threshold or equivalent is appropriate for offset lithographic printing and letterpress printing materials.

For purposes of determining whether the recommended 15 lb/day actual VOC emissions applicability threshold or an equivalent threshold is met at a given facility, we recommend that an offset lithographic printer consider emissions from all offset

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[2] "Letterpress printing" means a printing process in which the image area is raised relative to the non-image area and the paste ink is transferred to the substrate directly from the image surface.

[3] - See. e.g., *Model Volatile Organic Compound Rules for Reasonably Available Control Technology: Planning for Ozone Nonattainment Pursuant to Title I of the Clean Air Act*, dated June 1992 (establishing the 15 lb of VOC per day applicability threshold for coating applications for eleven industries, including, automobile and light duty truck coating operations and coating of cans, coil, paper, fabric, vinyl, metal furniture, large appliances, magnet wire, miscellaneous metal parts, and flat wood paneling).

lithographic printing operations, including related cleaning activities at the facility prior to controls. Similarly, we recommend that a letterpress printer should consider emissions from all letterpress printing operations, including related cleaning operations at the facility prior to controls, in evaluating whether the 15 lb/day actual emissions applicability threshold or an equivalent threshold has been met.

We recommend a different applicability threshold for the RACT recommendations in this CTG relating to heatset web offset lithographic printing and letterpress printing operations. Specifically, we recommend applying the add-on control recommendations for heatset web offset lithographic printing operations and heatset web letterpress printing operations only to those presses with potential to emit from the dryer, prior to controls, of at least 25 tpy of VOC (petroleum ink oil) from heatset inks. We recommend providing printers with the option of using an enforceable limitation on potential emissions to keep an individual press below this 25 tpy potential to emit threshold. Guidance on limiting potential to emit from printing operations is provided in the Technical Support Document (TSD) for Title V Permitting of Printing Facilities (see Appendix A). We believe add-on control for heatset presses with potential to emit below 25 tpy is too costly for the emission reduction that would be achieved.

We also recommend excluding heatset presses used for book printing and excluding heatset presses with maximum web width of 22 inches or less from the add-on control recommendations. We believe add-on control for such heatset presses is too costly for the emission reduction that would be achieved.

We estimate that there are approximately 6,700 offset lithographic printing facilities in current ozone nonattainment areas that meet the 15 lb/day actual VOC emissions (before controls) applicability threshold described above. We derived this number based on available information concerning the offset lithographic printing industry. Specifically, in the 1993 draft CTG, we estimated that, as of the early 1990s, there were approximately 34,500 offset lithographic printing facilities in ozone nonattainment areas. We have information concerning the percentage of the U.S. population residing in nonattainment areas in the 1990 and 2000 Census. We believe it is reasonable to use these population figures to estimate the number of offset lithographic printing facilities in current nonattainment areas (i.e., areas based on the April 2004 designations). Specifically, given the percentage of U.S. population in ozone nonattainment areas in 1993, and the percentage of U.S. population in ozone nonattainment areas today, we estimate that 30,500 offset lithographic printing facilities are located in current ozone nonattainment areas. In the 1993 draft CTG, 78 percent of the model facilities emitted less than 15 lb/day before controls. Applying this percentage to the number of offset lithographic printing facilities in current ozone nonattainment areas, about 6,700 facilities emit 15 lb VOC per day or more. Based on a similar assessment, we estimate that less than 700 heatset web offset lithographic printing facilities in current ozone nonattainment areas have individual presses that are potentially affected by the 25 tpy potential to emit threshold described above.

We have limited information on the number of letterpress printing facilities in ozone nonattainment areas. In 1992, however, EPA's Office of Pollution Prevention and Toxics issued a report[3] which estimates that there are 21,000 facilities nationwide that are engaged in letterpress printing operations. Based on the percentage of the U.S. population in ozone nonattainment areas in 1990 and the percentage of U.S. population in ozone nonattainment areas in 2000), we estimate that approximately 11,000 of these facilities are located in current ozone nonattainment areas (based on April 2006 designations). In light of the similarities between letterpress and offset lithographic printing and the lack of specific data relevant to letterpress printers, we assume that approximately 80 percent of the letterpress facilities in current ozone nonattainment areas emit less than 15 lb of VOC per day and would therefore not be affected by this CTG. Applying this percentage to the number of letterpress printing facilities in current ozone nonattainment areas, about 2,200 facilities emit 15 lb/day actual VOC emissions (before controls) or more. There are very few heatset letterpress facilities anywhere in the U.S.

IV. Process Description and Sources of VOC Emissions

A. Offset Lithography

Offset lithography is a planographic method of printing. The term "planographic" denotes that the printing and non-printing areas are in the same plane on the surface of a thin metal lithographic plate. To maintain the distinction between the areas on the lithographic plate, the image area is rendered oil receptive, and the non-image area is rendered water receptive.

Offset lithography is an indirect printing method; that is, ink is not transferred directly to a substrate. Rather, ink is transferred from the lithographic plate to a rubber-covered, intermediate "blanket" cylinder and then transferred from the blanket cylinder to the substrate. The offset lithographic process is used for a broad range of printing applications, including books, magazines, periodicals, labels and wrappers, catalogs and directories, financial and legal documents, business forms, advertising brochures, newspapers, newspaper inserts, charts and maps, calendars, tickets and coupons, greeting cards, and stamps.

There are two types of offset lithography characterized by the method in which the substrate is fed to the press. In sheet-fed printing, individual sheets of paper or other substrate are fed to the press. In web printing, continuous rolls of substrate material are fed to the press and rewound or cut to size after printing. VOC emissions from offset lithographic printing result from the evaporation of components of the inks, fountain solutions, cleaning materials and other miscellaneous materials such as varnishes, coatings and glues. For a more complete description of these industry processes, refer to the 1993 draft CTG.

1. *Inks*

Offset lithographic printing inks are composed of pigments, vehicles, binders, and other additives. Offset lithographic inks are paste inks. Pigments provide the desired color and contain organic and inorganic materials. The vehicle is a solvent that carries pigment and binders, and is usually composed of petroleum oils and vegetable oils. Binders fix the pigment to the substrate and are composed of organic resins and polymers or oils and resins. Additives include waxes, lubricants, and driers.

Heatset web inks require heat to set the ink. Coldset web (also called non-heatset web) and sheet-fed inks dry by absorption into the substrate or by oxidation.

Heatset web inks may contain up to 45 percent VOCs (ink oils). In heatset web lithographic printing, 20 percent of the petroleum ink oils and essentially all of the vegetable ink oils are retained in the substrate and dry ink film. The remaining 80 percent of the petroleum ink oil is volatilized in and then exhausted from the dryer. Since the vegetable ink oil does not volatilize in the dryer, the amount of vegetable ink oil that can be used in heatset web offset lithographic inks is very limited. If there is too much vegetable oil in a heatset web offset lithographic ink, the ink will not dry properly.

The petroleum ink oils in sheet-fed and coldset web inks have higher boiling points than the ink oils in heatset inks. Coldset web inks usually contain below 35 percent VOC. Most sheet-fed inks contain below 25 percent VOC. In sheet-fed and coldset web offset lithographic printing, 95 percent of the petroleum ink oils and essentially all of the vegetable oils are retained in the substrate and dry ink film. The remaining 5 percent of petroleum ink oils is volatilized and emitted. Because of the high level of ink oil retention, emissions from sheet-fed and coldset web offset lithographic inks are inherently very low.

Some radiation (ultra-violet light or electron beam) cured materials are also used. Some printers use these materials in lieu of the heatset web printing process and others use them in conjunction with heatset web, coldset web or sheet-fed printing processes. Radiation cured materials generate minimal VOC emissions. Ultra-violet lamps or electron beam generators are used to dry and cure these materials.

Varnishes are unpigmented offset lithographic inks. They are applied on offset lithographic presses in the same manner (i.e., using a lithographic printing plate, fountain solution and blanket cylinder) as offset lithographic ink. Heatset varnishes are unpigmented heatset inks. The emissions generated by heatset varnishes are similar in nature to the emissions generated by heatset inks and they can be controlled in the same manner. Sheet-fed and coldset web varnishes are unpigmented sheet-fed and coldset web inks. Sheet-fed and coldset web

varnishes exhibit the same high level of ink oil retention and generate the same inherently low emissions as sheet-fed and coldset web inks. The coatings used on offset lithographic presses are predominantly waterbased or radiation (ultra-violet or electron beam) cured materials which generate minimal VOC emissions. We recommend that varnishes and coatings used on offset lithographic printing presses be considered part of the offset lithographic printing process and that the recommendations described below in section VI for heatset web offset lithographic inks and dryers apply equally to varnishes. We recommend that varnishes and coatings used on offset lithographic printing presses not be considered as a separate process (e.g., paper coating).

2. *Fountain Solution*

Fountain solution is applied to the lithographic plate to render the non-image areas unreceptive to ink. Since offset lithographic printing inks are oil-based, the fountain solution is water-based. The fountain solution contains small amounts of gum Arabic or synthetic resins, acids, and buffer salts to maintain the pH of the solution, and a wetting agent or "dampening aid" to enhance the spreadability of the fountain solution across the plate. The dampening aid reduces the surface tension of water as well as increases viscosity.

Isopropyl alcohol traditionally has been used as a dampening aid. Other alcohols such as ethanol and n-propyl alcohol may also be used. Before the 1980's, the concentration of alcohol in the fountain solution was sometimes as high as 35 percent, with the concentration in most presses falling between 15 and 20 percent. Over the last 20 years, printers have greatly reduced the alcohol content of fountain solution. Also in the last 20 years, non-alcohol dampening aids have been developed. These alcohol substitutes are typically glycol ethers or ethylene glycol, and achieve the same purpose as alcohol.

3. *Cleaning Materials*

Cleaning materials are used to remove excess printing inks, oils, and residual paper from press equipment. These materials are typically mixtures of organic (often petroleum-based) solvents. The cleaning material may be a solvent such as kerosene (which contains numerous organics), or a specific mixture of individual solvents. Cleaning materials are used to wash the blankets, rollers, and outside of presses, and to remove residues of excess ink between color changes. Cleaning may be done manually, for example using shop towels, or using an automatic blanket wash systems.

B. Letterpress Printing

1. *Inks*

Letterpress inks are similar to offset lithographic inks. They are paste inks containing petroleum oils or vegetable oils. Both sheet-fed and web presses are used for letterpress printing.

Sheet-fed letterpress presses use coldset inks. Most web letterpress equipment use coldset inks. These letterpress inks are similar in composition and behavior to sheet-fed and coldset web lithographic inks. In sheet-fed and coldset web letterpress printing, 95 percent of the petroleum ink oils and essentially all of the vegetable oils are retained in the substrate and dry ink film. The remaining 5 percent of petroleum ink oils is volatilized and emitted. Because of the high level of ink oil retention, emissions from sheet-fed and coldset web letterpress inks are inherently very low.

There are also some heatset web letterpress printers. Heatset letterpress ink is similar to heatset lithographic ink with 20 percent of the petroleum ink oils and essentially all of the vegetable ink oils retained in the substrate and dry ink film. The remaining 80 percent ink oil is volatilized in and then exhausted from the dryer. Since the vegetable ink oil does not volatilize in the dryer, the amount of vegetable ink oil that can be used in heatset letterpress inks is very limited. If there is too much vegetable oil in a heatset letterpress ink, the ink will not dry properly.

2. *Cleaning Materials*

Cleaning materials are used to remove excess printing inks, oils, and residual paper from press equipment. The cleaning materials used for letterpress printing are similar to those used in offset lithographic printing. These materials are typically mixtures of organic (often petroleum-based) solvents.

V. Available Control Options

There are three main sources of VOC emissions from offset lithographic printing: (1) evaporation of VOC (petroleum ink oils) from the inks; (2) evaporation of VOC from the fountain solution; and (3) evaporation of VOC from the cleaning materials. There are two main sources of VOC emissions from letterpress printing: (1) evaporation of VOC (petroleum ink oils) from the inks and (2) evaporation of VOC from the cleaning materials.

The three mechanisms to reduce VOC emissions from offset lithographic printing and letterpress printing are as follows:

- Add-on controls,
- Process modifications or work practices, and
- Material reformulation or substitution.

A. Inks

Inks are a significant source of VOC emissions from heatset web offset lithographic printing and heatset letterpress printing. In these processes, heat is applied in a dryer to set the inks. As a result of the heating process, about 80 percent of the petroleum ink oil (VOC) is volatilized in the dryer. The remaining 20 percent of petroleum ink oil and all of the vegetable ink oil is retained in the substrate and dry ink film.

Most heatset web offset lithographic printing dryers are equipped with control devices such as a thermal oxidizer, catalytic oxidizer, or chiller condenser (condenser filter). These same control devices can also be used on heatset letterpress dryers. These control devices significantly reduce VOC emissions from heatset web printing. Oxidizers are more widely used than condenser filters, with catalytic oxidizers being slightly more popular than thermal oxidizers. At the time the 1993 draft CTG was being developed, new oxidizers generally were capable of achieving 95 percent or greater destruction efficiency, but chiller condensers were only capable of achieving 90 percent.

Oxidizers and condenser filters may not be able to achieve the above stated destruction or recovery efficiencies when the VOC concentration of the stream entering the control device is too low. Oxidizers tend to have a rather constant outlet concentration around 20 ppmv as compound. As a result, an oxidizer that achieves 90 percent destruction efficiency at inlet concentrations above 200 ppmv as compound may not be able to achieve this level of destruction efficiency at inlet concentrations below 200 ppmv as compound. Similarly, an oxidizer that achieves 95 percent destruction efficiency at inlet concentrations above 400 ppmv as compound may not be able to achieve this level of destruction efficiency at inlet concentrations below 400 ppmv as compound. Print jobs (e.g., book printing) with light coverage will yield low inlet concentrations. In addition, there are several instances, such as sources utilizing combined dryers and control devices that do not have an identifiable measurable inlet where the only option available is to measure the outlet concentration to demonstrate compliance.

Some printers use radiation (ultra-violet light or electron beam) cured materials in lieu of the heatset web printing process. These radiation cured materials generate minimal VOC emissions.

Some reduction in VOC emissions from heatset web offset lithographic inks and heatset letterpress inks could be achieved by increasing the use of vegetable oil and decreasing the use of petroleum oil. Since only very limited amounts of vegetable oil can be used in heatset inks, only a small emission reduction could be achieved and we do not believe this reduction would be cost-effective.

The VOC emissions from sheet-fed and coldset web lithographic inks and sheet-fed and coldset web letterpress inks are inherently very low. First, these inks are lower VOC-content inks than heatset web inks. Second, 95 percent of the petroleum ink oil and essentially all of the vegetable ink oil in sheet-fed and coldset web inks do not evaporate and are retained in the substrate and dry ink film. Because only a small percentage of the sheet-fed and coldset web ink oils evaporate, VOC emissions associated with these inks are small.

Some reduction in VOC emissions from sheet-fed and coldset web inks could be achieved by increasing the use of vegetable oil and decreasing the use of petroleum oil. Since 95 percent of the petroleum oil is retained, only a small emission reduction could be achieved and we do not believe this reduction would be cost-effective.

The limited VOC emissions that occur from sheet-fed and coldset web offset lithographic inks are diffuse and spread over a large area. These emissions are not amenable to add-on control. This is in contrast to the emissions associated with heatset offset web lithographic inks and heatset web letterpress inks, as the petroleum oils in those inks volatilize in a dryer and are more amenable to add-on control because they are emitted in a more concentrated form from a discrete source.

B. Fountain Solution

Fountain solutions can be the source of a significant portion of the VOC emitted by offset lithographic printing operations. Historically, alcohols such as isopropyl alcohol, n-propyl alcohol and ethanol were used as the dampening aid.

Before the 1980's, the concentration of alcohol in the fountain solution was sometimes as high as 35 percent, with the concentration in most presses falling between 15 and 20 percent. Over the last 20 years, printers have greatly reduced the alcohol content of fountain solution.

Cooling a fountain solution that contains isopropyl alcohol is a process modification that reduces VOC emissions by reducing the evaporation of the alcohol. Refrigerated circulators are available that can cool the fountain solution to a pre-set temperature of 55 to 60 ºF. Refrigeration also gives operators better control of ink emulsification and hot weather scumming, and stabilizes the ink/water balance by minimizing alcohol evaporation. Refrigeration of fountain

solution trays has been shown to reduce alcohol consumption by as much as 44 percent.

In addition, many printers have reduced VOC emissions by switching to alcohol substitutes, most commonly certain glycol ethers. These additives have higher boiling points and lower volatilities than traditional dampening aids. The additives are incorporated in small quantities (from 2 to 4 ounces in 1 gallon of water) to produce a final, mixed fountain solution that is usually less than 3 weight percent VOC.

C. Cleaning Materials

Cleaning materials can be the source of a significant portion of the VOC emitted by offset lithographic printing and letterpress printing operations. The keys to reducing VOC emissions from offset lithographic printing and letterpress printing cleaning materials are reducing the composite vapor pressure or VOC content of the material used, and work practices.

Cleaning materials with VOC composite vapor pressure less than 10 millimeters of mercury (mm Hg) at 20 ºC have been used successfully by many printers for blanket washing and other cleaning activities. Low VOC composite vapor pressure materials generate less VOC emissions than higher vapor pressure cleaning materials. As noted in the ACT document, cleaning materials with VOC composite vapor pressure less than 10 millimeters of mercury (mm Hg) at 20 ºC when used in conjunction with good work practices achieve a comparable emission reduction to cleaning materials containing 30 weight percent VOC. For certain cleaning activities, such as metering roller cleaning or removing dried ink, higher vapor pressure cleaning materials may be required.

The VOC composite vapor pressure of a cleaning material is a weighted average of the vapor pressures of the VOC components of that cleaning material. The vapor pressure of each VOC component is weighted by the mole fraction of that VOC component in the whole cleaning material including non-VOC components such as water or exempt compounds. Water and exempt compounds thereby reduce the VOC composite vapor pressure of cleaning materials in which they are present.

Water-miscible cleaning materials with less than 30 weight percent VOC were developed and tested for offset lithographic printing in the early 1990's. These materials were recommended as RACT in the 1993 draft CTG. These materials did not provide adequate performance and therefore they are not being used by the offset lithographic printing industry today.

There are some water-miscible or exempt solvent containing cleaning materials that contain 70 weight percent VOC or less in use today. These lower VOC content materials are capable of performing many of the tasks, such as

metering roller cleaning, which cannot be performed with low VOC composite vapor pressure cleaning materials. A small number of cleaning tasks cannot be carried out with low VOC composite vapor pressure cleaning materials or reduced VOC content cleaning materials.

Work practices such as keeping solvent containers closed except when filling, draining or conducting cleaning operations, and keeping used shop towels in closed containers also reduce VOC emissions. Typically, 50 percent of a cleaning material with composite vapor pressure less than 10 mm Hg at 20 ºC will remain in used shop towels if the used towels are kept in closed containers.

D. Existing State and Local Regulations

In researching available control approaches for addressing VOC emissions associated with offset lithographic printing and letterpress printing, EPA reviewed existing state and local regulatory approaches. Seventeen states or local areas have VOC emission regulations for offset lithographic printing operations. Five states or local areas have regulations for letterpress printing operations. These rules generally limit the alcohol or alcohol substitute content of fountain solutions (for offset lithographic printers only) and the composite vapor pressure or VOC content of cleaning materials, and require control of heatset dryer exhaust. The tables in Appendices B and C list and describe the regulations that EPA reviewed.

VI. Recommended Control Options

Recommendations for controlling VOC emissions from heatset inks, fountain solution, and cleaning materials used in offset lithographic printing operatons, and for controlling VOC emissions from heatset inks and cleaning materials used in letterpress printing operations are as follows:

A. Heatset web offset lithographic and heatset letterpress inks and dryers

The recommended level of control for VOC emissions from heatset dryers is tied to the first installation date of the control device. The first installation date for a control device does not change if it is later moved to a new location. For example, a brand new control device first installed in 1992 is moved to a new location in 1998 – the first installation date for this control device is still 1992. The first installation date for a control device does not change if it is later used to control a new press. For example, a brand new heatset press is installed in 2009 and emissions from this press are controlled by a control device that was first installed in 2002 - the first installation date for this control device is still 2002.

The recommended level of control for VOC emissions from heatset dryers is 90 percent control efficiency for a control device whose first installation date was prior to the effective date of a State RACT rule issued after the date of this CTG. The recommended level of control for VOC emissions from heatset dryers

is 95 percent control efficiency for a control device whose first installation date was on or after the effective date of a State RACT rule issued after the date of this CTG.

We recommended a 90 percent control efficiency in the 1993 draft CTG and this efficiency is currently required by most state and local regulations for heatset web offset lithography. At the time the 1993 draft CTG was being developed, new oxidizers generally were capable of achieving 95 percent or greater destruction efficiency, but chiller condensers were only capable of achieving 90 percent. For a variety of reasons, including the 90 percent control efficiency recommendation in the 1993 draft CTG and the 90 percent control efficiency requirement in most existing state and local regulations, some oxidizers first installed between 1993 and the publication of this CTG may not be achieving 95 percent control device efficiency. We do not recommend retroactively requiring these oxidizers to achieve 95 percent control device efficiency.

To accommodate situations where the inlet VOC concentration is so low that a 90 or 95 percent efficiency may not be achievable, we recommend providing an outlet concentration alternative. Specifically we recommend providing an option to reduce the control device outlet concentration to 20 ppmv as hexane on a dry basis to accommodate situations where the inlet VOC concentration is low, or there is no identifiable measurable inlet.

As explained above in section III, we recommend applying the above recommended levels of control to individual heatset web offset lithographic printing presses with potential to emit from the dryer, prior to controls, of at least 25 tpy of VOC (petroleum ink oil). We also recommend applying the above recommended levels of control to individual heatset web letterpress printing presses with potential to emit from the dryer, prior to controls, of at least 25 tpy of VOC (petroleum ink oil). We recommend providing printers with the option of using an enforceable limitation on potential emissions to keep an individual heatset press below this 25 tpy potential to emit threshold. This equates to using inks and coatings which contain less than 31.25 tpy VOC (petroleum ink oil) because of the 20 percent ink oil retention. We also recommend excluding heatset presses used for book printing and excluding heatset presses with maximum web width of 22 inches or less from the add-on control recommendations.

We believe that control of a press that is above the 25 tpy threshold will generally be cost effective. Control of a press that is below the 25 tpy threshold, presses used for book printing, and presses with maximum web width of 22 inches or less will generally not be cost effective.

We are not recommending control of VOC emissions from sheet-fed or coldset web inks, sheet-fed or coldset web varnishes, waterborne coatings or radiation (ultra-violet light or electron beam) cured materials used on offset

lithographic presses or letterpress presses. The VOC emissions from these materials are already low and they are not amenable to add-on control.

B. Fountain Solution

We recommend the following approaches for controlling VOC emissions from fountain solution. These recommended levels of control were recommended in the 1993 draft CTG and are required by certain existing state and local regulations.

- Heatset Web Offset Lithographic Printing
  The recommended level of control for VOC emissions from on-press (as-applied) fountain solution for heatset web offset lithographic printing is 1.6 percent alcohol (by weight) in the fountain or equivalent. There are at least three different approaches for achieving this level of control. The first approach involves reducing the on-press (as-applied) alcohol content to 1.6 percent alcohol or less (by weight). The second approach involves using 3 percent alcohol or less (by weight) on-press (as-applied) in the fountain solution if the fountain solution is refrigerated to below 60ºF (15.5ºC). The third approach involves using 5 percent alcohol substitute or less (by weight) on-press (as-applied) and no alcohol in the fountain solution.

- Sheet-fed Offset Lithographic Printing
  The recommended level of control for VOC emissions from on-press (as-applied) fountain solution for sheet-fed printing is equivalent to 5 percent alcohol (by weight) in the fountain or equivalent. There are at least three different approaches for achieving this recommended level of control. The first approach involves reducing the on-press (as-applied) alcohol content to 5.0 percent alcohol or less (by weight). The second approach involves using 8.5 percent alcohol or less (by weight) on-press (as-applied) in the fountain solution provided the fountain solution is refrigerated to below 60ºF (15.5 ºC). The third approach involves using 5 percent alcohol substitute or less (by weight) on-press (as-applied) and no alcohol in the fountain solution. This recommendation does not apply to sheet-fed presses with sheet size of 11 inches by 17 inches or smaller, and does not apply to any press with total fountain solution reservoir of less than 1 gallon.

- Coldset Web Offset Lithographic Printing
  The recommended level of control for VOC emissions from fountain solution for coldset web is 5 percent alcohol substitute or less (by weight) on-press (as-applied) and no alcohol in the fountain solution.

As explained more fully in Section III above, we recommend applying the control recommendations for offset lithographic printing fountain solution to any offset lithographic printing operation where the emissions associated with all aspects of that operation equal or exceed 6.8 kg/day (15 lb/day) actual emissions of VOC, or an equivalent level, before consideration of controls. State and local agencies may adopt different applicability criteria in their regulations. States should craft their applicability criteria in their State RACT rules based on consideration of the facts and circumstances of the facilities in their particular nonattainment areas.

We recommend that these control recommendations for fountain solution not be applied to sheet-fed presses with maximum sheet size 11x17 inches or smaller, or to any press with total fountain solution reservoir of less than 1 gallon. For these presses, the recommended VOC (alcohol or alcohol substitute) content levels would yield a small emission reduction relative to the cost of achieving that reduction (e.g., changing and maintaining rollers).

C. Cleaning Materials

The following recommendations apply to blanket washing, roller washing, plate cleaners, metering roller cleaners, impression cylinder cleaners, rubber rejuvenators, and other cleaners used for cleaning a press, press parts, or to remove dried ink from areas around a press. EPA recommends that when States develop RACT rules in response to the Industrial Cleaning Solvents CTG, see EPA 453/R-06-001 (Sept. 2006), they consider excluding from those rules the activities noted in the prior sentence, which are covered by this CTG. See 71 FR 44540. In addition, the recommendations for cleaning materials provided below do not apply to cleaners used on electronic components of a press, pre-press cleaning operations (e.g., platemaking), post-press cleaning operations (e.g., binding), cleaning supplies (e.g., detergents) used to clean the floor (other than dried ink) in the area around a press, or cleaning performed in parts washers or cold cleaners.

We recommend using cleaning materials with a VOC composite vapor pressure less than 10 mm Hg at 20 ºC or cleaning materials containing less than 70 weight percent VOC. We believe this combination of material recommendations will reduce VOC emissions and allow for use of a mix of materials capable of achieving all of the covered cleaning tasks. Cleaning materials with low VOC composite vapor pressure have been used successfully by many printers for blanket washing and other cleaning activities. Many of the cleaning tasks that cannot be carried out with low VOC composite vapor pressure cleaning materials can be carried out with reduced VOC content cleaning materials. We also recommend excluding 110 gallons per year of cleaning materials which meet neither the low VOC composite vapor pressure recommendation nor the lower VOC content recommendation because a small

number of cleaning tasks cannot be carried out with low VOC composite vapor pressure cleaning materials or reduced VOC content cleaning materials.

We also recommend that the following work practices be employed: keeping cleaning materials and used shop towels in closed containers. In the ACT document, EPA noted that using cleaning materials with a VOC composite partial vapor pressure less than 10 mm Hg at 20 ºC in conjunction with good work practices would result in an emission reduction that is comparable to using cleaning materials that contain less than 30 weight percent VOC.

As explained more fully in Section III above, we recommend applying the above control recommendations for offset lithographic printing cleaning materials to any offset lithographic printing operation where the emissions associated with all aspects of that operation equal or exceed 6.8 kg/day (15 lb/day) actual emissions of VOC, or an equivalent level, before consideration of controls. Similarly, we recommend applying the above control recommendations for letterpress printing cleaning materials to any letterpress printing operation where the emissions associated with all aspects of that operation equal or exceed 6.8 kg/day (15 lb/day) actual emissions of VOC, or an equivalent level, before consideration of controls. State and local agencies may adopt different applicability criteria in their regulations. States should craft their applicability criteria in their State RACT rules based on consideration of the facts and circumstances of the facilities in their particular nonattainment areas.

VII. Cost Effectiveness of Recommended Control Options

In the 1993 draft CTG, EPA estimated baseline emissions from the offset lithographic printing industry in ozone nonattainment areas, based on 1990 data, to be 820,000 tons per year (with 62,000 tpy coming from ink, 631,000 tpy from fountain solution and 126,000 tpy from cleaning). In the 1993 draft CTG, EPA also conducted a model plant analysis, in which it evaluated VOC emissions associated with different kinds of printing processes, the VOC emission reduction capabilities of various control options, and the costs of such controls. The model plants were developed to represent a range of sizes and emissions. See Appendix A (describing model plant analysis and EPA's VOC emission reduction and cost estimates).

Commenters on the 1993 draft CTG asserted that the alcohol content (17 percent) used to generate this estimate was too high and that the assumed ratio of fountain solution usage to ink usage was also too high. Baseline VOC emissions from fountain solution may have been overestimated in 1993 by a factor of 2 to 3, which would mean that industrywide baseline emissions in 1990 ranged from approximately 400,000 to 500,000 tpy. As for letterpress printers, we have limited emissions information for this industry. Based on available information, we estimate that VOC emissions from the letterpress printing industry as of 1990 were about 28,000 tons per year.

We believe that the model plant analysis in the 1993 draft CTG is representative of current operations in the offset lithographic printing industry and current control options. The significant control approaches addressed in the 1993 draft CTG are the same approaches that are available today, and those approaches continue to represent the most effective means of controlling VOC emissions from offset lithographic printers. We also believe that the model plant analysis accurately presents the costs associated with the control approaches identified in the 1993 document. We recognize, however, that the costs in that draft document are presented in first quarter 1990 dollars and must be adjusted to represent current costs. Accordingly, for purposes of estimating the cost-effectiveness of the recommended control approaches in this document, we escalated the 1990 costs in the 1993 draft CTG, to 2005 costs using a cost index.[4] The escalated costs are presented in Table 1 below. (See Appendix D for additional cost information.)

Table 1. Cost Effectiveness Values for Recommended Control Approaches for Offset Lithographic Printing

Control Technique	$ Per Ton VOC Removed[a]
Control of VOC from heatset inks	2,010
Control of VOC from fountain solutions	estimated savings[b]
Control of VOC from cleaning materials	855

[a] Costs from 1990 are escalated to 2005 costs by use of a Marshall and Swift Equipment Cost Index (Chemical Engineering Magazine).
[b] Reduction in alcohol use or conversion to alcohol substitutes results in a cost savings.

Because of the similarities between offset lithographic printing and letterpress printing in terms of the nature of the processes at issue, the sources of VOC emissions and available control approaches, it is reasonable to assume that the cost-effectiveness estimates in Table 1 for control of VOC from heatset inks and control of VOC from cleaning materials apply equally to the letterpress printing industry.

VIII. Factors to Consider in Determining VOC Emissions from Offset Lithographic Printing and Letterpress Printing

This section provides a summary of some of the recommendations EPA has previously made to States concerning factors that may be considered in determining VOC emissions from offset lithographic printing and letterpress printing operations. These factors are important for a number of reasons including determining whether a facility or a press exceeds the applicability thresholds recommended in this CTG or other applicability thresholds that a state may consider including in its regulations. The factors described below and other relevant factors are discussed in the 1993 draft CTG, the 1994 ACT and the 2005 Printing TSD.

A. Ink Oil Retention

Heatset Inks – We recommend using a 20 percent VOC retention factor for petroleum ink oils and a 100 percent retention factor for vegetable ink oils in heatset inks. The VOC emissions, before consideration of any control, from a

heatset ink would therefore be 80 percent of the petroleum ink oil content. The petroleum ink oil content of a heastet ink can be determined from formulation data (e.g., technical data sheet or material safety data sheet). We believe that a Method 24 test of a heatset ink will volatilize the petroleum ink oils and will not volatilize the vegetable ink oils.

Sheet-fed and coldset web inks - We recommend using a 95 percent VOC retention factor for petroleum ink oils and a 100 percent retention factor for vegetable ink oils in sheet-fed and coldset web inks. The VOC emissions from a sheet-fed or coldset web ink would therefore be 5 percent of the petroleum ink oil content. The petroleum ink oil content of a sheet-fed or coldset web ink can be determined from formulation data (e.g., technical data sheet or material safety data sheet). We believe that an EPA Method 24 test of a sheet-fed or coldset web ink will volatilize the petroleum ink oils and will not volatilize the vegetable ink oils. The ASTM method D6419 (Standard Test Method for Volatile Content of Sheet-Fed and Coldset Web Offset Printing Inks) is a more precise method for determining the volatile (petroleum ink oil) content of sheet-fed and coldset web inks than ASTM D2369 which is referenced in EPA Method 24.

B. Retention of Low VOC Composite Vapor Pressure Cleaning Materials in Shop Towels

We recommend using a 50 percent VOC retention factor for low VOC composite vapor pressure cleaning materials in shop towels where (1) VOC composite vapor pressure of the cleaning material is less than 10 mm Hg at 20 ºC, and (2) cleaning materials and used shop towels are kept in closed containers.

C. Carryover of VOC from Automatic Blanket Wash and Fountain Solution to Offset Lithographic Heatset Dryers

We recommend using a 40 percent VOC carryover (capture) factor for automatic blanket washing when the VOC composite vapor pressure of the cleaning material is less than 10mm Hg at 20°C.

We recommend using a 70 percent VOC carryover (capture) factor for alcohol substitutes in fountain solution.

D. Capture of Petroleum Ink Oil in Heatset Dryers

For heatset web offset lithographic presses and heatset web letterpress presses, we believe capture efficiency for VOC (petroleum ink oils) from oil-based paste inks and oil-based paste varnishes (coatings) can be demonstrated by showing that the dryer is operating at negative pressure relative to the surrounding

pressroom. We recommend that as long as the dryer is operated at negative pressure, the capture efficiency for VOC from the heatset lithographic inks and varnishes (coatings) formulated with low volatility ink oils can be assumed to be 100 percent of the VOC (ink oils) volatilized in the dryer. We do not recommend conducting a capture efficiency test in this situation.

Conventional heatset lithographic inks and varnishes are paste-type materials. The VOC in these materials are oils with high boiling points, which volatilize only within the dryer. Some ink oils, nominally 20 percent, are not volatilized and remain in the substrate. If other types (e.g., fluid type) of coating materials are used on a heatset lithographic press or a heatset letterpress press, we recommend that capture efficiency testing be conducted for the VOC from these other materials if the printer wants to take into account the effect that the dryer controls have on VOC emissions from these other types of coatings. The most common other types of coatings materials used on heatset presses are waterbased or radiation (ultra-violet light or electron beam) cured materials which generate minimal VOC emissions.

E. Methods 25 and 25A

We recommend using EPA Method 25A in lieu of EPA Method 25 for determining the destruction efficiency of an oxidizer (inlet and outlet concentrations) when:

- An exhaust concentration of 50 or less parts per million volume (ppmv) as carbon (C1) is required to comply with the applicable standard;
- The inlet concentration and the required level of control results in an exhaust concentration of 50 or less ppmv as C1; or
- The high efficiency of the control device alone results in an exhaust concentration of 50 or less ppmv as C1.

In situations where M25 is not viable, such as those described in section 1.1 of M25, we recommend the use of M25A on both the inlet and outlet.

IX. References

1. Guideline Series: Control of Volatile Organic Compound Emissions from Offset Lithographic Printing. Draft. U.S. Environmental Protection Agency. Research Triangle Park, NC. September 1993.

2. Alternative Control Techniques Document: Offset Lithographic Printing. EPA 453/R-94-054. U.S. Environmental Protection Agency. Research Triangle Park, NC. June 1994.

3. Use Cluster Analysis of the Printing Industry. Office of Pollution Prevention and Toxics. Office of Pollution Prevention and Toxics. May 1992.

4. Marshall and Swift Equipment Cost Index. Chemical Engineering Magazine. McGraw-Hill. (www.che.com)

5. Model Volatile Organic Compound Rules for Reasonably Available Control Technology: Planning for Ozone Nonattainment Pursuant to Title I of the Clean Air Act. U.S. Environmental Protection Agency. Research Triangle Park, NC. June 1992.

6. Technical Support Document (TSD) for Title V Permitting of Printing Facilities, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, January 2005.

Appendix A

Access to 1993 draft CTG, 1994 ACT, and 2005 TSD

Guideline Series: Control of Volatile Organic Compound Emissions from Offset Lithographic Printing. Draft. U.S. Environmental Protection Agency. Research Triangle Park, NC. September 1993.

Available as a separate item in docket EPA-HQ-OAR-2006-0536 and on the internet at http://www.epa.gov/ttn/atw/print/draftlithoctg.pdf .

Alternative Control Techniques Document: Offset Lithographic Printing. EPA 453/R-94-054. U.S. Environmental Protection Agency. Research Triangle Park, NC. June 1994.

Available as a separate item in docket EPA-HQ-OAR-2006-0536 and on the internet at http://www.epa.gov/ttn/atw/print/lact.pdf .

Technical Support Document (TSD) for Title V Permitting of Printing Facilities, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, January 2005.

Available as a separate item in docket EPA-HQ-OAR-2006-0536 and on the internet at http://www.epa.gov/ttn/oarpg/t5/memoranda/tsd.pdf .

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Appendix B

State and Local Regulations for Offset Lithographic Printing

Agency, Rule Number and Applicability

State or Local Agency	Offset Lithography	Applicability
Bay Area Air Quality Management District	Regulation 8 Rule 20	http://www.baaqmd.gov/dst/regulations/rg0820.pdf 8-20-110 175 lb VOC per month
San Joaquin Valley Unified Air Pollution Control District	Rule 4607 – Graphic Arts	No cutoff http://www.valleyair.org/rules/currntrules/r4607.pdf 2.0 Applicability This rule is applicable to any graphic arts printing operation, to any paper or fabric coating operation, to the organic solvent cleaning, and to the storage and disposal of solvents and waste solvent materials associated with such operations as defined in Section 3.0 of this rule.
San Diego County Air Pollution Control District	Rule 67.16 – Graphic Arts Operations	http://www.sdapcd.org/rules/rules/Reg4pdf/R67-16.pdf (1) The provisions of Sections (d) and (e) of this rule shall not apply to stationary sources which emit less than an average of 15 lbs (6.8 kg) of volatile organic compounds (VOCs) from all graphic arts operations per day of operation for each calendar month.
South Coast Air Quality Management District	Rule 1130 – Graphic Arts, Rule 1171 – Solvent Cleaning Operations	http://www.aqmd.gov/rules/reg/reg11/r1130.pdf no cutoff
Delaware	CAP 24.47 – Offset Lithographic Printing	http://www.dnrec.state.de.us/air/aqm_page/docs/pdf/reg_24.pdf 15 lb/day 2. This Section does not apply to any offset lithographic printing facility whose total actual volatile organic compound (VOC) emissions from all lithographic printing operations (including emissions from cleaning solutions used on lithographic printing presses) are less than 6.8 kilograms (kg) (15 pounds [lb]) VOCs per day before the application of capture systems and control devices. or maintains a maximum dryer exhaust outlet concentration of 20 parts per million by volume (ppmv) as methane (as C1), whichever is less stringent when the press is in operation.

Georgia	391-3-1-02 Provisions. Amended, (2)(ddd) - VOC Emissions from Offset Lithography	25 tpy 100 tpy 3. The requirements of this subsection shall apply to facilities with VOC emissions exceeding 25 tons per year and located in the counties of Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding and Rockdale and to facilities with potential VOC emissions exceeding 100 tons per year and located in the counties of Bartow, Carroll, Hall, Newton, Spalding, and Walton.
Illinois	35.215.408 – (Heatset Web), 35.218.407 – Lines on and after March 15, 1996, and 35.219.407 – Lines on and after March 15, 1996	Old rule? http://www.ipcb.state.il.us/documents/dsweb/Get/Document-11924/ Section 215.408 Heatset Web Offset Lithographic Printing a) No owner or operator of a heatset web offset lithographic printing facility, located in Cook, DuPage, Kane, Lake, Macoupin, Madison, McHenry, Monroe, St. Clair or Will County, emitting over 100 tons/year of organic material, in the absence of pollution control equipment, may cause or allow the operation of a heatset web offset press unless: 1) An incinerator system is installed and operated that oxidizes at least 90 percent of the organic materials (measured as total combustible carbon) in the dryer exhaust airstream to carbon dioxide and water; or 2) The fountain solution contains no more than eight (8) percent, by weight, of volatile organic material and a condensation recovery system is installed and operated that removes at least 75 percent of the non-isopropyl alcohol organic materials from the dryer exhaust airstream. b) No owner or operator of a heatset web offset lithographic printing facility, located in a county other than Cook, DuPage, Kane, Lake, Macoupin, Madison, McHenry, Monroe, St. Clair or Will County, emitting over 100 tons/year of organic material, in the absence of pollution control equipment, may cause or allow the operation of a heatset web offset press unless the fountain solution contains no more than eight (8) percent, by weight, of volatile organic material. (Source: Added at 11 Ill. Reg. 16706, effective September 30, 1987)
Kansas	28-19-76 – Lithography Printing Operations	http://www.kdheks.gov/bar/download/AIRREGS2005new.pdf **28-19-76. Lithography printing operations.** (a) The provisions of this regulation shall apply to all offset lithography printing facilities with a potential contaminant emission rate of volatile organic compounds (VOC) equal to or more than 100 tons per year. The potential contaminant emission rate calculations may include federally enforceable permit conditions. (b) The provisions of this regulation do not apply to: (1) printing on fabric, metal or plastic; (2) sheet fed lithographic presses with cylinder widths of 26 inches or less; or (3) web lithographic presses with cylinder widths of 18 inches or less. (c) Any owner or operator of an offset lithographic printing press subject to this regulation
Maryland	26.11.19.11 – Lithographic Printing	http://www.dsd.state.md.us/comar/26/26.11.19.11.htm no cutoff for some items, 100 lb/day from web presses for heatset dryer control, 18 inch width for sheet fed ftn soln limits

Massachusetts	310 CMR 7.26 – (24) Non-Heatset Operations, (27) Printers with Heatset Presses or Non-conforming Operations	Complex, but less than major http://www.mass.gov/dep/service/regulations/310cmr07.pdf
Missouri	10 CSR 10-2.340 and 10 CSR 10-5.442, Control of Emissions from Lithographic Printing	2.340 Kansas City http://www.sos.mo.gov/adrules/csr/current/10csr/10c10-2.pdf (B) This regulation shall apply to installations that have calculated actual volatile organic compound (VOC) emissions for a known number of crewed hours, increased by the amount by weight of VOCs whose emission into the atmosphere is prevented by the use of air pollution control devices and extrapolated to eight thousand seven hundred sixty (8,760) hours per year equal to or greater than one hundred (100) tons per year from offset lithographic printing presses after December 9, 1991. The following factors shall be taken into consideration unless an alternative 5.442 St. Louis http://www.sos.mo.gov/adrules/csr/current/10csr/10c10-5.pdf (B) This rule shall apply only to installations described in subsection (2)(A) which have ever had the potential to emit VOCs equal to or greater than one hundred (100) tons per year. Once the installation exceeds the applicability level of this rule, it shall remain subject to this rule even if its potential emissions drop below the applicability level. (C) This rule shall not apply to printing on fabric, metal or plastic.
New Hampshire	Env-A 1204.37 – Applicability Criteria and Compliance Standards	http://www.des.state.nh.us/Rules/pdf/env-a1200.pdf (a) A source whose offset lithographic printing operations have combined TPEs during any consecutive 12-month period after December 31, 1989 which equal or exceed 50 tons of VOCs shall be subject to the provisions of this section. (cy) "Theoretical potential VOC emissions" (TPEs) means the emissions of VOCs that would have occurred prior to the application of add-on controls required by a federally enforceable rule or document issued prior to January 1, 1990, based on one of the following: (1) Continuous operation of 8760 hours per year under maximum production capacity, which for coating and graphic arts sources includes coatings and inks with the highest VOC content used in practice by the source during 1993 and 1994 or the 2-year period most representative of normal production rates; or (2) Hours of operation, process conditions, or both that are limited by federally enforceable permit conditions;

New York	6 Part 234 – Graphic Arts	http://www.dec.state.ny.us/website/regs/part234.html NYC metro (b) Any packaging rotogravure, publication rotogravure, flexographic, offset lithographic printing process or screen printing process at any facility located in the New York City metropolitan area, regardless of its annual potential to emit volatile organic compounds, must comply with this Part according to the following schedule. (3) . . . Any offset lithographic printing process which was constructed on or before September 1, 1988 regardless of annual potential to emit must have demonstrated compliance with this Part by May 15, 1991. (4) Any owner or operator of a packaging rotogravure, publication rotogravure, flexographic or offset lithographic printing process which was constructed after September 1, 1988 must have demonstrated compliance with this Part upon start-up. Lower Orange County metro (c) Any owner or operator of a packaging rotogravure, publication rotogravure, flexographic or offset lithographic printing process or screen printing process at any facility located in the Lower Orange County metropolitan area must comply with this Part according to the following schedule: (3) Any owner or operator of a packaging rotogravure, publication rotogravure, flexographic, offset lithographic printing process or screen printing process at any facility for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 25 tons must: Rest of state (d) Any owner or operator of a packaging rotogravure, publication rotogravure, f1exographic, offset 1ithographic printing process, or screen printing process at any facility located outside the New York City metropolitan area and Lower Orange county metropolitan area must comply with this Part according to the following schedule: (3) Any owner or operator of a packaging rotogravure, publication rotogravure, flexographic, offset lithographic printing process, or screen printing process at any facility for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 50 tons must:
North Carolina	15A NCAC 02Q.0803 – Coating, Solvent Cleaning, Graphic Arts Operations	This is a title V exclusionary rule, not a RACT rule http://daq.state.nc.us/rules/rules/Q0800.pdf Mecklenburg County VOC rules (nothing on litho) **http://tinyurl.com/peemj**

Tennessee	1200-3-18.43 – Offset Lithographic Printing Operations	http://www.state.tn.us/sos/rules/1200/1200-03/1200-03-18.pdf **1200-3-18-.43 OFFSET LITHOGRAPHIC PRINTING OPERATIONS.** (1) Applicability of this rule is as follows: (a) This rule applies to offset lithographic printing operations in Davidson, Rutherford, Shelby, Sumner, Williamson, and Wilson Counties. (b) The emission limits of this rule do not apply to offset lithographic printing operations within any facility whose potential VOC emissions from all offset lithographic printing operations within the facility are less than 100 tons of volatile organic compounds (VOC's) per year.
Texas	30 Section 115.442 – Control Requirements	http://www.tceq.state.tx.us/assets/public/legal/rules/rules/pdflib/115e.pdf starts at 115.440 **§115.449. Counties and Compliance Schedules.** (a) In El Paso County, all offset lithographic printing presses shall be in compliance with §§115.442, 115.443, 115.445, and 115.446 of this title (relating to Control Requirements; Alternate Control Requirements; Testing Requirements; and Monitoring and Recordkeeping Requirements) as soon as practicable, but no later than November 15, 1996. (b) In Collin, Dallas, Denton, and Tarrant Counties, all offset lithographic printing presses on a property which, when uncontrolled, emit a combined weight of volatile organic compound (VOC) equal to or greater than 50 tons per calendar year, shall be in compliance with §§115.442, 115.443, 115.445, and 115.446 of this title as soon as practicable, but no later than December 31, 2000. (c) In Collin, Dallas, Denton, and Tarrant Counties, all offset lithographic printing presses on a property which, when uncontrolled, emit a combined weight of VOC less than 50 tons per calendar year, shall be in compliance with §§115.442, 115.443, 115.445, and 115.446 of this title as soon as practicable, but no later than one year, after the commission publishes notification in the *Texas Register* of its determination that this contingency rule is necessary as a result of failure to attain the national ambient air quality standard (NAAQS) for ozone by the attainment deadline or failure to demonstrate reasonable further progress as set forth in the 1990 Amendments to the Federal Clean Air Act (FCAA), §172(c)(9). (d) In Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, all offset lithographic printing presses on a property which, when uncontrolled, emit a combined weight of VOC equal to or greater than 25 tons per calendar year, shall be in compliance with §§115.442, 115.443, 115.445, and 115.446 of this title as soon as practicable, but no later than December 31, 2002. (e) In Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, all offset lithographic printing presses on a property which, when uncontrolled, emit a combined weight of VOC less than 25 tons per calendar year, shall be in compliance with §§115.442, 115.443, 115.445, and 115.446 of this title as soon as practicable, but no later than one year, after the commission publishes notification in the *Texas Register* of its determination that this contingency rule is necessary as a result of failure to attain the NAAQS for ozone by the attainment deadline

Virginia	9 VAC 5-40-7820 – Standard for Volatile Organic Compounds	http://www.deq.virginia.gov/air/regulations/air40.html see article 53 9VAC5-40-7800. Applicability and designation of affected facility. A. Except as provided in subsections C, D, and E of this section, the affected facility to which the provisions of this article apply is each lithographic printing process which uses a substrate other than a textile. B. The provisions of this article apply only to sources of volatile organic compounds in the Northern Virginia or Richmond Volatile Organic Compound Emissions Control Area designated in 9VAC5-20-206. C. Exempted from the provisions of this article are facilities in the Northern Virginia Volatile Organic Compound Emissions Control Area whose potential to emit is less than 10 tons per year of volatile organic compounds, provided the emission rates are determined in a manner acceptable to the board. All volatile organic compound emissions from printing inks, coatings, cleaning solutions, and fountain solutions shall be considered in applying the exemption levels specified in this subsection. D. Exempted from the provisions of this article are facilities in the Richmond Volatile Organic Compound Emissions Control Area whose potential to emit is less than 100 tons per year of volatile organic compounds, provided the emission rates are determined in a manner acceptable to the board. All volatile organic compound emissions from printing inks, coatings, cleaning solutions, and fountain solutions shall be considered in applying the exemption levels specified in this subsection. E. The provisions of this article do not apply to the following: 1. Printing processes used exclusively for determination of product quality and commercial acceptance provided: a. The operation is not an integral part of the production process; b. The emissions from all product quality printing processes do not exceed 400 pounds in any 30 day period; and c. The exemption is approved by the board. 2. Photoprocessing, typesetting, or imagesetting equipment using water-based chemistry to develop silver halide images. 3. Platemaking equipment using water-based chemistry to remove unhardened image-producing material from an exposed plate. 4. Equipment used to make blueprints. 5. Any sheet-fed offset lithographic press with a cylinder width of 26 inches or less.
Wisconsin	NR 422.142 – Lithographic Printing, NR 423.035 – Industrial Cleaning Operations	http://www.legis.state.wi.us/rsb/code/nr/nr422.pdf **NR 422.142 Lithographic printing. (1)** APPLICABILITY. (a) This section applies to all lithographic printing presses at any facility which is located in the county of Kenosha, Kewaunee, Manitowoc, Milwaukee, Ozaukee, Racine, Sheboygan, Washington or Waukesha and which has maximum theoretical emissions of VOCs from all lithographic printing presses at the facility greater than or equal to 755.7 kilograms (1666 pounds) in any month. (b) To determine VOC emissions under par. (a), the VOC content of a lithographic ink shall be multiplied by 0.8 for a heatset ink, or multiplied by 0.05 for a non−heatset ink, to account for VOC retention on the substrate.

Fountain Solution Limits

1) San Joaquin Valley Unified Air Pollution Control District
Effective 9/17/2000 – 8 percent VOC by volume as applied

2) San Diego County Air Pollution Control District
15 percent by volume VOC as applied

3) South Coast Air Quality Management District
Effective January 1, 2000 – 80 grams per liter VOC as applied or 100 grams per liter as applied if a refrigerated chiller is used

4) Bay Area AQMD
8 percent VOC by volume

5) Delaware
For heatset web presses: 1.6 percent or less by volume or 3 percent or less by volume if the fountain solution is refrigerated to less than 15.6 ºC (60 ºF)

For non-heatset web presses: alcohol content in the fountain solution shall be eliminated; non-alcohol additives or alcohol substitutes may be used to accomplish the total elimination of alcohol use

For sheet-fed presses: 5 percent or less by volume or 8.5 percent or less by volume if the fountain solution is refrigerated to below 15.6 ºC (60 ºF)

Any type of offset lithographic printing press is in compliance if the only VOC's in the fountain solution are in non-alcohol additives or alcohol substitutes so that the concentration of VOCs' in the fountain solution is 3 percent or less by weight. (The fountain solution shall not contain any alcohol.)

6) Georgia
8 percent or less by volume VOC

7) Illinois
8 percent or less VOC by weight

8) Kansas
Continuously contain 10 percent or less by weight of alcohol (alcohol is defined as isopropanol or isopropyl alcohol) or fountain solution is refrigerated to a temperature of 55 ºF or less for alcohol-based solutions

9) Maryland

8.5 percent isopropyl alcohol by weight; fountain solution is refrigerated to maintain a temperature of less than 55 ºF if isopropyl alcohol is used

10) Massachusetts

For facilities that will not have a usage rate of all VOC-containing compounds exceeding 670 gallons per calendar month or a facility-wide emission rate of VOC exceeding 2.5 tons per calendar month:

Non-heatset: for web presses installed on or after May 1, 1998, the fountain solution shall not contain any alcohol.

Sheet-fed presses with cylinder widths greater than 21 inches: 3 percent alcohol by volume, or 5 percent alcohol by volume and fountain solution refrigerated to a temperature of less than 60 ºF.

Sheet-fed presses with cylinder widths less than or equal to 21 inches: 5 percent alcohol by volume

Newspaper printing – 0 percent alcohol

Any VOC-containing additive other than alcohol shall be limited to a mix ratio that will result in a VOC concentration in the fountain solution, excluding alcohol, equal to or less than 2.5 percent volume by alcohol.

For facilities with the potential to emit, before the application of air pollution control equipment, equal to or greater than 50 tons per year of VOC (310 CMR 7.18(25)(a):

Sheet-fed offset lithographic press using propanol in fountain solution: 5 percent VOC by volume as applied or 8 percent VOC by volume as applied with fountain solution refrigerated to a temperature below 60 ºF

Web fed offset lithographic press using propanol in fountain solution: 1.6 percent VOC by volume as applied or 3 percent VOC by volume as applied with fountain solution refrigerated to a temperature below 60 ºF

Non-heatset web-fed offset lithographic press: 0 percent propanol and maintain a total VOC concentration of 2.5 percent or less by weight

Propanol Substitute Requirements: Any person subject to 310 CMR 7.18(25)(a), who owns, leases, operates, or controls an offset lithographic press with fountain solution with propanol substitutes, containing a concentration of VOC in the fountain solution at 3.0 percent by volume or less, shall be considered in compliance with the VOC emission limitations for fountain solutions contained in 310 CMR 7.18(25).

For **large printers[1] and midsize printers[2]:**

The following standards apply to midsize and large printers, except that they do not apply to the fountain solution in a press with a fountain solution reservoir that holds less than or equal to one gallon.

Web-fed Presses: fountain solution shall not contain any alcohol.

Sheet-fed Presses:

a. unrefrigerated fountain solution containing alcohol shall contain no more than 5 percent VOC by weight, including but not limited to alcohol, and;

b. refrigerated fountain solution containing alcohol shall contain no more than 8 percent VOC by weight, including but not limited to alcohol, and shall be refrigerated to a temperature of less than 60° F.

[1] **Large printer** - a printer that uses a total of more than 3,000 gallons of cleanup solution and inks/coatings/adhesives with a VOC content greater than 10 percent by weight as applied, per rolling12 month period, where incidental material, ink used in non-heatset offset lithographic printing, waterbased ink/coating/adhesive, plastisol and ultraviolet ink are excluded from this calculation

[2] **Midsize printer** - a printer that uses a total of more than 275 and no more than 3000 gallons of cleanup solution and inks/coatings/adhesives with a VOC content greater than 10 percent by weight as applied, per rolling 12 month period, or that uses a total of more than 55 gallons of alcohol per rolling 12 month period and a total of no more than 3000 gallons of cleanup solution, and inks/coatings/adhesives with a VOC content greater than 10 percent by weight as applied, per rolling 12 month period, where incidental material, ink used in non-heatset offset lithographic printing, water-based ink/coating/adhesive, plastisol and ultraviolet ink are excluded from this calculation

11) Missouri

(Kansas City) 10 percent or less alcohol by weight and fountain solution refrigerated to 55 ºF or less for alcohol based solutions

(St. Louis) heat set web: 1.6 percent or less by volume of alcohol, or 3 percent or less by volume of alcohol and fountain solution is refrigerated to a temperature of 60 ºF or less, or 5 percent or less by volume of alcohol substitutes

(St. Louis) sheet-fed: 5 percent or less by volume of alcohol, or 8.5 percent or less by volume of alcohol and fountain solution is refrigerated to a temperature of 60 ºF or less, or 5 percent or less by volume of alcohol substitutes or combination of alcohol and alcohol substitutes

(St. Louis) non-heatset web: 5 percent or less by volume of alcohol substitutes, or 5 percent or less by volume of a combination of alcohol and alcohol substitutes

12) New Hampshire

Heatset web: 1.6 percent or less by weight, or 3 percent or less by weight if the fountain is refrigerated to a temperature below 60 ºF, or 5 percent or less by weight if the fountain solution contains no alcohol

Sheet-fed: 5 percent VOC or less by weight, or VOC content of 8.5 percent or less by weight if the fountain solution is refrigerated to a temperature below 60 ºF

Fountain solution used in a non-heatset web-fed offset lithographic printing process, including both newspaper and non-newspaper facilities, shall contain no alcohol and the concentration of total VOC's shall not exceed 5 percent by weight in the final solution.

13) New York

10 percent or less by weight of VOC

14) North Carolina

None found

15) Tennessee

Heatset web: 1.6 percent VOC by volume as applied, or 3 percent VOC by volume as applied if the fountain solution is refrigerated to less than 60 ºF, or 4.6 percent VOC by volume as applied and use no alcohol in the fountain solution, or 6 percent VOC by volume as applied if the fountain solution is refrigerated to less than 60 ºF and use no alcohol in the fountain solution

Non-heatset web: No owner or operator of a non-heatset web offset printing press subject to this rule shall apply any fountain solution that contains alcohol, nor shall any fountain solution be applied unless the VOC content is equal to or less than 5 percent by weight of the fountain solution as applied.

Sheet-fed: 5 percent VOC by volume as applied, or 8.5 percent by volume as applied is the fountain solution is refrigerated to less than 60 ºF

16) Texas

Heatset web: Any person who owns or operates a heatset web offset lithographic printing press that uses alcohol in the fountain solution shall maintain total fountain solution alcohol to 5.0 percent or less by volume. Alternatively, a standard of 10.0 percent or less by volume alcohol may be used if the fountain solution containing alcohol is refrigerated to less than 60 degrees Fahrenheit.

Nonheatset web newspaper: Eliminate the use of alcohol in the fountain solution. Non-alcohol additives or alcohol substitutes can be used to accomplish the total elimination of alcohol use.

Nonheatset web non-newspaper: 5.0 percent or less by volume or 10.0 percent or less by volume alcohol may be used if the fountain solution is refrigerated to less than 60 ºF.

Sheet fed: 10.0 percent or less by volume or 12.0% or less by volume alcohol may be used if the fountain solution is refrigerated to less than 60 ºF.

Any person who owns or operates any type of offset lithographic printing press shall be considered in compliance with the fountain solution limitations of this paragraph if the only VOCs in the fountain solution are in nonalcohol additives or alcohol substitutes, so that the concentration of VOCs in the fountain solution is 3.0 percent or less by weight. The fountain solution shall not contain any isopropyl alcohol.

17) Virginia

Heatset web:

a. When the fountain solution contains alcohol:

(1) The fountain solution shall contain no more than a daily average of 1.6 percent volatile organic compounds by weight; or
(2) The temperature of the fountain solution shall be maintained at or below 60 ºF and the fountain solution shall contain no more than a daily average of 3.0 percent volatile organic compounds by weight; or

b. When the fountain solution contains no alcohol, the fountain solution shall contain no more than a daily average of 5.0 percent volatile organic compounds by weight.

Non-heatset web presses and each newspaper presses: the fountain solution shall contain no alcohol and shall contain no more than a daily average of 5.0 percent volatile organic compounds by weight.

Sheet-fed press:

a. The fountain solution shall contain no more than a daily average of 5.0 percent volatile organic compounds by weight; or

b. The temperature of the fountain solution shall be maintained at or below 60 ºF and the fountain solution shall contain no more than a daily average of 8.5 percent volatile organic compounds by weight.

18) Wisconsin

Heatset web presses: any person who owns or operates a heatset web lithographic printing press shall, when printing on a substrate other than metal, metal-foil or plastic, use a fountain solution which has a VOC content as applied of no more than one of the following:

a. 1.6 percent by weight if the fountain solution contains any restricted alcohol and is not refrigerated to 60 ºF or less.

b. 3.0 percent by weight if the fountain solution contains any restricted alcohol and is refrigerated to 60°F or less.

c. 5.0 percent by weight if the fountain solution contains no restricted alcohol.

Non-heatset web presses: any person who owns or operates a non-heatset web lithographic printing press shall, when printing on a substrate other than metal, metal-foil or plastic, use a fountain solution which has a VOC content as applied of no more than 5.0 percent by weight and which contains no restricted alcohol.

Sheet-fed presses: any person who owns or operates a sheet-fed lithographic printing press shall, when printing on a substrate other than metal, metal-foil or plastic, use a fountain solution which has a VOC content as applied of no more than one of the following:

a. 5.0 percent by weight.

b. 8.5 percent by weight if the fountain solution is refrigerated to 60 ºF or less.

Metal, metal-foil or plastic substrates: any person who owns or operates any lithographic printing press shall, when printing on a metal, metal-foil or plastic substrate, use a fountain solution which has a VOC content as applied of no more than one of the following:

a. 13.5 percent by weight if the fountain solution contains any restricted alcohol and is refrigerated to 60 ºF or less.

b. Not more than 1.6 percent by weight if the fountain solution contains any restricted alcohol and is not refrigerated to 60 ºF or less or 5.0 percent by weight if the fountain solution contains no restricted alcohol for **heatset web**; not more than a VOC content as applied of 5.0 percent by weight and which contains no restricted alcohol for **non-heatset** web; and not more than a VOC content as applied of 5.0 percent by weight for **sheet-fed presses**.

Appendix C

State and Local Regulations for Letterpress Printing

Letterpress State and Local Rules – Ink VOC Content Limits

State	Ink VOC Content Limit (lb/gal as applied, less water)
San Diego Rule 67.16	2.5
San Joaquin Valley[1] Rule 4607	2.5
South Coast[1] Rules 1130 (printing) and 1171 (cleaning)	2.5
Massachusetts 310 CMR 7.26 – (25)	2.5
Wisconsin[2] NR 423.035 (cleaning)	----

1. This limit is expressed as lb/gal as applied, less water and less exempt compounds.
2. Wisconsin only has rules for industrial solvent cleaning operations.

Letterpress State and Local Rules – Cleaning Solutions

State	Cleaning Solution VOC Content Limit (grams/liter)	Cleaning Solution VOC Composite Partial Vapor Pressure, millimeters of mercury (mm Hg) at 20 ºC	Cleaning Solution VOC Content Limit (lb/gal)
San Diego[1]	200	45	
San Joaquin Roller Wash – Step 1	600	10	5.0
San Joaquin Roller Wash – Step 2, Blanket Wash, and On-press Components	800	10	6.7
San Joaquin Removable Press Components	50	10	0.42
South Coast Roller Wash – Step 1	500		4.2
South Coast Roller Wash – Step 2, Blanket Wash, and On-press Components	500		4.2
South Coast Removable Press Components	25		0.21
Massachusetts		25	
Wisconsin On-press Components[2]			
Wisconsin Removable Press Components	50		0.42

1. Total vapor pressure
2. A maximum VOC content of 30% by weight

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Appendix D

Estimated Costs Associated with the Recommendations Contained in the Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing

This appendix presents the estimated costs associated with implementing the recommendations in the CTG for controlling volatile organic compounds (VOCs) emissions from offset lithographic printing and letterpress printing facilities in ozone nonattainment areas. As explained in the CTG, the CTG is guidance for State and local pollution control agencies to use in determining "reasonably available control technology" (RACT) for VOCs from offset lithographic printing and letterpress printing. State and local pollution control agencies are free to adopt the recommendations contained in the CTG, or implement other technically-sound approaches for RACT, provided those approaches 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 contained in the CTG. For purposes of this analysis, we assume that all states will adopt the recommendations in the CTG.

Costs are presented below for installing and operating control equipment to reduce VOC emissions from heatset dryers, and for reducing emissions from cleaning through the use of low VOC composite vapor pressure (less than or equal to 10mm Hg at 20 degrees C) and low VOC content (less than 70 weight percent VOC) cleaning materials.

Estimated nationwide total annual cost of CTG recommendations for offset lithographic printing - heatset dryers

The nationwide total annual cost of the CTG recommendations for offset lithographic printing heatset dryers is estimated to be $33 million.

As shown in Tables 1 through 3, this is based on estimates in the 1993 draft CTG with adjustments made for the number of facilities in nonattaiment areas today versus 1993, 2005 dollars versus first quarter 1990 dollars and the number of facilities already achieving the recommendations in this CTG today versus the number of facilities achieving the 1993 draft recommendations in 1993.

Table 1

Col A	Col B	Col C	Col D	Col E
		B*53/60	B*0.4	C*0.2
heatset litho model plants	# facilities in nonatt areas in 1993 draft CTG	# facilities in nonatt areas today	# facilities in nonatt areas in 1993 w/o dryer controls	# facilities in nonatt areas today w/o dryer controls
A-I	77	68	30	14
A-II	122	108	48	22
A-III	319	282	127	57
A-IV	308	272	123	55

Table 1 Notes

In 1993, 60 percent of US population was in ozone nonattainment areas. Today, 53 percent of US population is in ozone nonattainment areas.

In 1993, 60 percent of heatset dryers were assumed to already be controlled and 40 percent were assumed to be uncontrolled. Today, 80 percent of heatset dryers are assumed to already be controlled and 20 percent are assumed to be uncontrolled.

Table 2

Col A	Col B	Col C	Col D B/C	Col E D*1.36
Heatset litho model plants	total annual cost from 1993 draft CTG Table E-1	# of facilities installing controls in 1993	total annual cost of control per facility (1st quarter 1990 dollars)	total annual cost of control per facility (2005 dollars)
A-I	$1,513,392	30	$50,446	$68,607
A-II	$4,433,742	48	$92,370	$125,623
A-III	$20,464,574	127	$161,138	$219,148
A-IV	$27,614,987	123	$224,512	$305,336

A cost escalation factor of 1.36 was used to convert first quarter 1990 dollars to 2005 dollars.

Table 3

Col A	Col B	Col C	Col D B*C
Heatset litho model plants	# facilities in nonatt areas today w/o dryer controls	total annual cost of control per facility (2005 dollars)	total annual cost of control (2005 dollars)
A-I	14	$68,607	$960,499
A-II	22	$125,623	$2,763,699
A-III	57	$219,148	$12,491,447
A-IV	55	$305,336	$16,793,504
TOTAL			$33,009,150

Estimated nationwide total annual cost of CTG recommendations for offset lithographic printing – cleaning

The nationwide total annual cost of the CTG recommendations for cleaning associated with offset lithographic printing is estimated to be $18 million.

As shown in Tables 4 through 6, this is based on estimates in the 1993 draft CTG with adjustments made for the number of facilities in nonattaiment areas today versus 1993, 2005 dollars versus first quarter 1990 dollars and the number of facilities already achieving the recommendations in this CTG today.

Table 4

Col A	Col B	Col C B*53/60	Col D	Col E D*0.4
model plants	# facilities in nonatt areas in 1993 draft CTG	# facilities in nonatt areas today	# facilities in nonatt areas today above cutoff	# facilities in nonatt areas today above cutoff and not already meeting cleaning recommendations
heatset				
A-I	77	68	68	27
A-II	122	108	108	43
A-III	319	282	282	113
A-IV	308	272	272	109
coldset web				
B-I	158	140	140	56
B-II	535	473	473	189
B-III	1,198	1,058	1,058	423
B-IV	397	351	351	140
sheet fed				
C-I	14,362	12,686	0	0
C-II	12,131	10,716	0	0
C-III	2,624	2,318	2,318	927
C-IV	1,733	1,531	1,531	612
newspaper				
D-I	419	370	0	0
D-II	93	82	82	33
D-III	42	37	37	15
D-IV	21	19	19	7
D-V	8	7	7	3
D-VI	4	4	4	1

Table 4 Notes

In 1993, 60 percent of US population was in ozone nonattainment areas. Today, 53 percent of US population is in ozone nonattainment areas.

The two smallest size sheet-fed model facilities and the smallest size newspaper model facility do not exceed the 15 lb/day cutoff.

In 1993, no facilities were assumed to be meeting the draft recommendations for cleaning. Today, at least 60 percent of facilities are assumed to already be meeting the recommendations for cleaning because over 60 percent of the nonattainment area population is in areas which already have state or local VOC rule for offset lithography.

Table 5

Col A	Col B	Col C	Col D B/C	Col E D*1.36
Model plants	total annual cost from 1993 draft CTG Table E-3 (1st quarter 1990 dollars)	# facilities in nonatt areas in 1993 draft CTG	total annual cost of control per facility (1st quarter 1990 dollars)	total annual cost of control per facility (2005 dollars)
Heatset				
A-I	$84,080	77	$1,092	$1,485
A-II	$292,755	122	$2,400	$3,263
A-III	$1,529,563	319	$4,795	$6,521
A-IV	$2,685,126	308	$8,718	$11,856
coldset web				
B-I	$172,527	158	$1,092	$1,485
B-II	$1,283,805	535	$2,400	$3,264
B-III	$5,744,251	1,198	$4,795	$6,521
B-IV	$3,461,022	397	$8,718	$11,856
sheet fed				
C-I	$6,323,589	14,362	$440	$599
C-II	$10,682,559	12,131	$881	$1,198
C-III	$9,242,778	2,624	$3,522	$4,790
C-IV	$12,971,678	1,733	$7,485	$10,180
newspaper				
D-I	$276,729	419	$660	$898
D-II	$184,266	93	$1,981	$2,695
D-III	$151,639	42	$3,610	$4,910
D-IV	$151,639	21	$7,221	$9,820
D-V	$119,409	8	$14,926	$20,300
D-VI	$96,514	4	$24,129	$32,815

Table 5 Notes

A cost escalation factor of 1.36 was used to convert first quarter 1990 dollars to 2005 dollars.

Table 6

Col A	Col B	Col C	Col D B*C
Model plants	# facilities in nonatt areas today above cutoff and not already meeting cleaning recommendations	total annual cost of control per facility (2005 dollars)	total annual cost of control (2005 dollars)
heatset			
A-I	27	$1,485	$40,403
A-II	43	$3,263	$140,679
A-III	113	$6,521	$735,006
A-IV	109	$11,856	$1,290,293
coldset web			
B-I	56	$1,485	$82,905
B-II	189	$3,264	$616,911
B-III	423	$6,521	$2,760,304
B-IV	140	$11,856	$1,663,136
sheet fed			
C-I	0	$440	$0
C-II	0	$881	$0
C-III	927	$4,790	$4,441,463
C-IV	612	$10,180	$6,233,324
newspaper			
D-I	0	$660	$0
D-II	33	$2,695	$88,546
D-III	15	$4,910	$72,868
D-IV	7	$9,820	$72,868
D-V	3	$20,300	$57,380
D-VI	1	$32,815	$46,378
TOTAL			$18,342,463

United States Environmental Protection Agency	Office of Air Quality Planning and Standards Sector Policies and Programs Division Research Triangle Park, NC	Publication No. EPA 453/R-06-002 September 2006