Ohio EPA
Division of Air Pollution Control
Engineering Section
Engineering Guide #56

Questions:

This guide addresses the following questions, which are arranged by subject matter, pertaining to heatset web offset printing lines (HWOPL's).

General:

(1) What are the liquid organic materials employed within a HWOPL?

(2) Are emissions from HWOPL's to be treated as "organic materials," pursuant to OAC Chapter 3745-21, or as "particulate matter," pursuant to OAC Chapter 3745-17?

OAC Rule 3745-17-07:

(3) Is OAC rule 3745-17-07 applicable to HWOPL's?

(4) If a HWOPL is in compliance with OAC rule 3745-21-07(G), is it eligible for an equivalent visible emission limitation (EVEL)?

(5) Is a HWOPL eligible for a variance from OAC rule 3745-17-07 without conducting particulate stack testing?

OAC Rule 3745-17-11:

(6) How is the mass emission limit from OAC rule 3745-17-11 calculated if such rule is applicable to HWOPL's?

OAC Rule 3745-21-07:

(7) Explain what OAC rule 3745-21-07(G)(3) means in terms of the applicable emission limits for HWOPL's.

(8) How are cleanup materials to be regulated pursuant to OAC rule 3745-21-07(G)(4)?

(9) In OAC rule 3745-21-07(G)(5), how is the determination of emissions within 12 hours of printing to be made?

(10) What control equipment and process modifications are available for HWOPL's and can such control equipment meet the requirements in OAC rule 3745-21-07(G)(6)?

(11) Explain paragraphs (G)(9)(c) through (G)(9)(g) of OAC rule 3745-21-07 and any applicability they may have to HWOPL's.

Air Quality:

(12) Do HWOPL emissions impact ozone air quality, total suspended particulate air quality, both or neither?

New Source Review:

(13) What is "best available technology" (BAT) for HWOPL's?

(14) Are new HWOPL's eligible for the exemption in OAC rule 3745-21-07(G)(9)(f)?

Test Methods and Compliance Demonstrations:

(15) Which test method should be used for mass emissions from HWOPL's?

(16) How should Method 25 test results, which are in terms of the weight of carbon, be converted to the weight of "organic materials" in order to determine compliance with the organic materials emission limitations in paragraphs (G)(1) and (G)(2) of OAC rule 3745-21-07?

(17) What is the test for determining if the liquid organic material comes into contact with flame or is baked, heat-cured, or heat-polymerized, in the presence of oxygen, per OAC rule 3745-21-07(G)?

(18) What demonstration is necessary to show that HWOPL emissions are not "photochemically reactive" for OAC rule 3745-21-07(G)(9)(f)?

(19) Is capture efficiency testing necessary for a HWOPL?

(20) How often and what method should be used to demonstrate negative pressure in the press dryer?

(21) How are organic compound emissions from HWOPL's to be calculated?

(22) Under what operating conditions should compliance tests be conducted?

(The majority of these specific questions were submitted by RAPCA on July 30, 1982. Other questions have been added by the DAPC and the printing industry for purposes of clarification.)

Answers:

The DAPC's answers to these questions are as follows:

General:

(1) The liquid organic materials employed in a HWOPL consist of fountain solution, printing ink, and cleanup solvent.

(2) Any evaporative pollutant emissions from a printing unit (consisting of fountain solution tray, ink tray, and associated rollers) should be entirely organic compound vapors and, therefore, should be treated as organic materials. Emissions from a dryer, which are always vented directly through a stack, should be treated as organic materials (both vapor and liquid aerosol phases) and particulate matter. [There are particulate emissions from the dryer due to condensible organic material and fuel combustion (e.g., natural gas, fuel oil and/or recovered ink oil).] Once the printed material has exited the dryer, any further emissions are organic materials.

OAC Rule 3745-17-07:

(3) OAC rule 3745-17-07 refers to visible particulate emissions. For HWOPL's, the particulate emissions are those emissions from the dryer(s) that would be collected in the filter portion of a USEPA Method 5 sampling train. This collected material would consist of condensed organic materials and other particulates.

Organic materials which do not condense at a temperature below 248 $\pm$ 25°F (the prescribed Method 5 filter box temperature) are not particulate emissions because they would not be captured by the filter and, therefore, are not subject to OAC rule 3745-17-07.

The July 1985 draft review of the New Source Performance Standards (NSPS) for asphalt concrete plants discusses the issue of condensing hydrocarbons. The draft states:

> "Observers of VE during NSPS performance tests should note that condensing emissions that develop downwind of the plant are not included in the

Method 9 observations."

This statement can be used as a guide for HWOPL's. If visible emissions develop downwind of the stack, these visible emissions should not be included in Method 9 readings and would not be subject to OAC rule 3745-17-07.

If the discharge from a dryer in a HWOPL contains any visible emissions, a particulate emission stack test may be necessary to demonstrate compliance with OAC rule 3745-17-11. The results of that test will help determine whether or not visible emissions are "visible particulate emissions." By reviewing the amount of particulate collected in the front half of the train versus that collected in the back half (condensible particulate), the field office can make this determination and, thereby, be able to determine the compliance status with OAC rule 3745-17-07.

(4) A HWOPL is not eligible for an EVEL only on the basis of compliance with OAC rule 3745-21-07(G). Since OAC rule 3745-17-07 regulates only visible particulate emissions, eligibility for an EVEL must be shown by demonstrating compliance with the particulate emission limitation in OAC rule 3745-17-11 pursuant to OAC rule 3745-17-07(C).

(5) The answer to this question depends on the reasons why the owner/operator does not want to perform particulate stack testing. If testing is economically and technically feasible, there are no grounds for a variance pursuant to OAC rule 3745-35-03. In such cases, particulate testing should be required; and if compliance with the particulate emission limitation in OAC rule 3745-17-11 is demonstrated, the owner/operator should obtain an EVEL. On the other hand, if the owner/operator can adequately demonstrate that such testing could not be performed in order to obtain an EVEL due to economic unreasonableness, technical infeasibility, or conditions beyond his control, and the HWOPL could be shown to be in compliance with the particulate emission limitation in OAC rule 3745-17-11 by acceptable alternative methods (e.g., reliable emission factor or material balance), then there may be grounds for a variance from OAC rule 3745-17-07.

OAC Rule 3745-17-11:

(6) OAC rule 3745-17-11 does apply to HWOPL's. However, it appears that HWOPL's should meet the requirements of OAC rule 3745-17-11 without any additional control measures. Limited stack test data suggest that the uncontrolled mass rate of emission (UMRE) is less than 10 lbs/hr (in which case Figure II of the rule would not apply) and that the limitation from Table I of the rule is achieved. The UMRE for use in Figure II is obtained by testing the inlet to the control equipment (if controlled) or by testing the stack (if uncontrolled). If Figure II is

applicable, the "grouping" provisions in OAC rule 3745-17-11(A)(3) must be followed in the case of multiple HWOPL's. The allowable emission rate from Table I (if applicable) is based on the maximum process weight rate (PWR) of fountain solution, printing ink and cleanup materials employed in the HWOPL. (The weight of the web is not included in the process weight rate since it does not cause any appreciable particulate emissions.)

OAC Rule 3745-21-07:

(7) Since a HWOPL is series of printing units with one or more dryers in which a continuously moving web is processed, the use of liquid organic materials in a HWOPL is subject to OAC rule 3745-21-07(G)(3), provided OAC rule 3745-21-07(G) applies to such HWOPL. (See OAC rule 3745-21-07(A) for provisions on applicability.) The limits under OAC rule 3745-21-07(G)(3) are explained in the next two paragraphs. The limits pertain to the entire HWOPL and not to the individual printing units and/or the dryer(s) within the HWOPL.

When employing a liquid organic material that is a photochemically reactive material [as defined in OAC rule 3745-21-01(C)(5)], OAC rule 3745-21-07(G)(3) indicates that the limitations in paragraph (G)(2) apply to the entire HWOPL (i.e., printing units, dryer, chill rolls, etc.). The limitations state that the organic material emissions shall not exceed 8 lbs/hour and 40 lbs/day, unless they have already been reduced by at least 85 percent. For example, if a HWOPL emits 6 lbs/hour and 54 lbs/day of organic materials, the daily emissions should be reduced to at least 40 lbs/day in order to comply. On the other hand, if a HWOPL emits 12.5 lbs/hour and 300 lbs/day of organic materials, the daily emissions should be reduced to at least 45 lbs/day (representative of 85 percent control) in order to comply. Assuming that the hourly emissions are reduced by a similar percentage, the 8 lbs/hour limitation is easily met.

When employing a liquid organic material that is not a photochemically reactive material, paragraph (G)(3) states that the limitations in paragraph (G)(1) apply collectively to only the equipment (e.g., dryers) described in paragraph (G)(1). (All other equipment, such as printing units, are exempt.) Thus, all dryers within an individual HWOPL in which any liquid organic material comes into contact with flame or is baked, heat-cured, or heat-polymerized, in the presence of oxygen, must collectively meet the limitations in paragraph (G)(1). These limitations state that the organic material emissions shall not exceed 3 lbs/hour and 15 lbs/day, unless they have already been reduced by at least 85 percent. See Table 1 of Attachment I for additional information.

(8) The cleanup materials, if they are photochemically reactive materials, are subject to the appropriate limitations in paragraph (G)(3) of OAC rule 3745-21-07 for the

type of equipment being cleaned, pursuant to paragraph (G)(4) of the same rule. The total organic material emissions from the cleanup of a press and/or dryer with photochemically reactive materials must be added to the other emissions of organic materials from the same press and/or dryer being cleaned during any hour and any day in order to determine compliance.

(9) Reworded, it is necessary to know how to determine the residual solvent in the printed material after 12 hours. According to USEPA, there is no formal EPA test method for determining residual solvent retained in printed matter.

The Compilation of Air Pollution Emission Factors document (AP-42, 4/81, Table 4.9.1-1, reports that the solvent remaining in the web and destroyed in the dryer is 40 percent for hot air dryers and 60 percent for direct flame dryers ("B" emission factor rating). These percentages may overstate the amount of solvent retained in the web since the solvent evaporated from the web in the first 12-hours and the solvent destroyed in the dryer are included.

Recent documentation issued by USEPA provides updated guidance on residual solvent content in printed matter. USEPA's draft Control Technique Guideline (CTG) document entitled "Control of Volatile Organic Compound Emissions from Offset Lithographic Printing" (September, 1993) recognizes that a 20 percent ink oil retention factor (for lithographic printing only) is appropriate for estimating the ink oil content of heatset ink retained by the substrate. Until acceptable test methods are developed by the USEPA to accurately determine the amount of solvent retained in the web, the field offices should assume that the solvent retained is 20 percent of the total ink solvent (oil) used. The 20 percent value should not be applied to any solvent in the fountain solution since such solvents should readily evaporate from the web in the dryer. The Engineering Section believes that 20 percent is a conservative figure which should apply to any type of web and which should give consideration to the 12-hour time period (which in any event should not be a significant factor since most printed material is tightly packaged or bound, thereby limiting solvent loss during this period). If any regulated entity requests a solvent retention credit of greater than 20 percent, it must satisfactorily demonstrate to the field office and the Engineering Section that a higher percentage is appropriate. The procedures for any such demonstration should be approved by the field office after consultation with the Engineering Section prior to initiation of testing.

(10) Process modifications will for the most part be limited to reformulations of printing ink, fountain solution, and cleanup solvent. After reformulation to all non-photochemically reactive materials, a press would be exempt from the requirements of paragraph (G)(1), (G)(2) and (G)(3), provided that the dryer is not

a direct flame dryer and that the liquid organic material has not been baked, heat-cured or heat polymerized in the presence of oxygen. It should be mentioned here that should a company wish to replace a direct flame dryer with an indirect type, the change would not constitute a "modification," and a permit to install would not be necessary. This is because there essentially is no increase in emissions, and the switch could be viewed as a compliance strategy. However, the installation of "pull-back" burners, which allow the use of both natural gas and oil for firing in a dryer, would require a PTI if the installation would involve a fuel switch from natural gas to oil. (Oil means fuel oil or recovered printing ink oil.)

Regarding control equipment, the following systems have been used to control hydrocarbon emissions from HWOPL's:

(a) A condensing-filtration system consists of one or more cooling sections, which employ air and/or water mediums for heat exchange to reduce the incoming exhaust gas temperature to a level (about 90-100°F) that causes condensation of the hydrocarbon pollutants, and a coalescing filtration section generally composed of fiberglass wool for the removal of the condensed hydrocarbons. Some systems follow this with a carbon filter. The carbon filter appears to have merit primarily where the prime concern is opacity and odor control. The key to the system is proper design and adequate cooling in the heat exchanger during the summer months. Control efficiencies in the range of 70 to 92 percent of the hydrocarbons in the exhaust gas have been reported. One advantage of the condensing-filtration systems is that solvent can be recovered. Generally, the recovered solvent is not recycled as an ink oil in the press, but is either sold to a reclaimer or used as an alternate fuel.

(b) A thermal incineration system consists of a chamber fired with gas or oil for hydrocarbon destruction. Because thermal incineration requires temperatures in the 1000 to 1350°F range, thermal incineration is usually not selected unless heat recovery is provided. Control efficiencies for these systems are reported in the range of 88 to 100 percent (typically 95 percent) for hydrocarbon emissions. They can be equipped with heat recovery.

(c) A catalytic incineration system consists of a chamber with a gas or oil burner and a catalyst bed for destruction of hydrocarbon pollutants at lower temperatures (about 625 to 950°F) than a thermal incineration system. Control efficiencies for these systems are reported in the range of 53 to 99 percent (typically 90 percent) of the hydrocarbons in the exhaust gas. They can also be equipped with heat recovery. With the high cost of fuels, these units have gained popularity.

(d) An electrostatic precipitation system consists of a module containing a pre-filter, ionizer, collection cell (where the electrically charged particles are collected), and an afterfilter. Control efficiencies for these systems have been reported to be at or above 85 percent. Solvent recovery is, provided by this system. It has been reported that due to very high maintenance costs this system is now seldom used in this industry.

(11) Paragraph (G)(9)(c) provides an exemption from paragraph (G) of this rule for water-based solvents. It states that if (1) the volatile content of the material employed consists only of water and a liquid organic material, (2) the liquid organic material comprises not more than 20 percent of the total volatile content by volume, and (3) the volatile content is not a photochemically reactive material (by definition), then the emissions from the use of the material are exempt from the requirements specified in paragraph (G) of the rule. For example, as applied to HWOPL's, consider a fountain solution consisting of 84 percent water and 16 percent isopropanol (isopropyl alcohol) by volume. Since this solution is only water and a liquid organic material, the content is not more than 20 percent and isopropanol is not photochemically reactive material [per definition in OAC rule 3745-21-01(C)(5)], these emissions are exempt and should not be counted when evaluating the HWOPL's compliance status.

Paragraph (G)(9)(d) provides an exemption from paragraph (G) of this rule for high solids inks and coatings that contain not more than 20 percent volatile content by volume, provided that the volatile content is not a photochemically reactive material. As applied to HWOPL's, an ink containing 83 percent solids and 17 percent volatile material, which is not a photochemically reactive material, meets this exemption. However, the inks used in HWOPL's generally contain more than 20 percent volatiles by volume. Therefore, this exemption will be of limited or no use to HWOPL's.

Paragraph (G)(9)(e) provides an exemption from paragraph (G) of this rule for a high boiling liquid organic material, provided such material is not exposed to temperatures greater than 220°F. In general, this exemption will not apply to HWOPL's because the high boiling printing ink oil is exposed to oven temperatures of 250°F or higher.

Paragraph (G)(9)(f) provides an exemption from paragraph (G) of this rule for any material used in any equipment, which is subject to paragraph (G)(1) through (G)(4) of the rule, if it can be demonstrated to the Ohio EPA that the organic material emissions from such equipment are not photochemically reactive. However, there is no definition of photochemically reactive emission in the rules. There is a definition in OAC rule 3745-21-01(C)(5) for liquid organic materials, but this definition does not apply to emissions. The intent in paragraph

(G)(9)(f) was to exempt non-photochemically reactive organic emissions. The DAPC will define, for purposes of evaluating this exemption, photochemically reactive emissions as those that are precursors to ozone formation. Presently, only those organic compounds that are excluded from the definition of "Volatile Organic Compound" in OAC Rule 3745-21-01(B)(6) have been classified by the USEPA as having negligible photochemical reactivity.

All other organic compounds are presumed to participate in the atmospheric formation of ozone unless the USEPA Administrator determines otherwise. (See answer 18 for further information.)

Paragraph (G)(9)(g) provides an exemption from paragraph (G) of this rule for any new source for which the Director has determined that best available technology is a control requirement or emission limitation that is either less stringent than or inconsistent with the requirements of paragraph (G) of OAC rule 3745-21-07. A permit to install for this new source must be issued by Ohio EPA in a manner that makes the control requirement or emission limitation enforceable by the USEPA. Also, the USEPA must approve the exemption in writing prior to the issuance of the final permit to install for the source. This exemption is not expected to be applicable to many new HWOPL's since currently available emission control systems easily meet BAT requirements and the use of non-photochemically reactive materials exempts HWOPL's from the requirements of OAC rule 3745-21-07(G).

Air Quality:

(12) There is no study known to the DAPC in which the emissions from HWOPL's were evaluated to determine their air quality impact. Based on stack test results, the emissions could impact both ozone and total suspended particulate air quality since both hydrocarbon and particulate emissions have been measured.

New Source Review:

(13) The determination of BAT for these sources is a multi-tiered analysis examining the following three items in descending priority:

1) compliance with OAC Chapters 3745-15, -17, -21 and

2) comparison of the proposed controls with those installed on similar sources; and

3) cost-effectiveness of the installation of controls.

This BAT determination is discussed below.

New sources are required to comply with the emission limitations for existing sources. There is no exception to this rule, and OAC rule 3745-35-03(C) specifically eliminates the possibility of a variance for any emission limitation which was applicable to the source as a new source. In the case of HWOPL's, compliance with OAC rules 3745-17-07, 3745-17-11 and 3745-21-07(G) must be assured before tho Ohio EPA can issue a permit to install.

In addition to compliance with OAC rules 3745-17-07, 3745-17-11 and 3745-21-07(G), a BAT determination should also examine other similar installations to evaluate the control measures being employed for the sources. It is important that similar sized sources be required to meet similar emission limits throughout the State.

Finally, if it has been determined that the same type and size of source has not been controlled, and the entity is proposing no control or controls that are less than "state-of-the-art," a cost-effectiveness study should be performed to determine what level of control is practical. The methodology described in Engineering Guide No. 46 should be followed to determine the "cost-effectiveness" of controls.

Typically, three types of control systems have been used on HWOPL's. They are catalytic incineration, thermal incineration and condenser-filter (condenser cooler) systems. Any well-designed incinerator or condenser cooler is capable of meeting the BAT requirement.

Catalytic incinerators are the most prevalent type of control that has been used on HWOPL's in Ohio. Destruction of organic compounds is achieved on a catalyst reaction bed. This system is capable of achieving a 90 percent destruction efficiency.

Thermal incinerators are not as common, but these devices have been installed on HWOPL's in Ohio. Thermal incineration achieves destruction of organic compounds through high temperature combustion. A 90 percent destruction efficiency also is achievable.

A condenser cooler system is a relatively new control device. Only a few have been installed on HWOPL's in Ohio, but these units are viable control devices. Under maximum operating conditions, condenser coolers can achieve a 90 percent control efficiency. It is important to note that under low operating rates a condenser cooler is not expected to achieve a consistent 90 percent control efficiency, but the unit is considered to meet the requirements of BAT since the allowable hourly mass emission limitation for the unit can be met.

In conclusion, BAT for any new (or modified) HWOPL's consists of the following:

1) From January 1, 1974 to December 31, 1980 - BAT is defined as compliance with OAC rules 3745-17-07, 3745-17-11 and 3745-21-07(G).

2) As of January 1, 1981

   a) New sources must comply with OAC rules 3745-17-07, 3745-17-11 and 3745-21-07(G).

   b) All new HWOPL's that have potential uncontrolled organic material emissions greater than 8 pounds per hour shall have the dryer(s) equipped with a control device. Potential uncontrolled emissions include emissions from the printing ink and fountain solution. Cleanup material should be evaluated separately. The determination of the potential uncontrolled organic material emissions should be based on the organic solvent content of printing ink and fountain solution.

      In some cases where existing sources (including any modified existing sources subject to a permit to install) are already controlled, or there is more than one new source, the combined emissions should be evaluated to determine if controls are cost-effective. In these instances, new sources with less than 8 pounds per hour of uncontrolled emissions may be required to reduce emissions.

   c) For all new HWOPL's that have been required to install a control device, it has been determined that a minimum 90 percent (by weight of organic material) control efficiency at maximum operating rate is BAT. (Organic material emissions in both the liquid and vapor phases are included in the control efficiency measurement.) BAT can also be expressed as maximum pounds per hour of organic material emissions from the dryer and from the entire HWOPL. [For example, a HWOPL's control device may not consistently achieve 90 percent control efficiency at low production rates. Specifying BAT as compliance with a 90 percent control efficiency or a maximum pounds per hour (from the control device) limitation addresses this problem.]

(14) New sources (i.e., those sources whose installations commenced on or after February 15, 1972) are eligible for the exemption in OAC rule 3745-21-07(G)(9)(f) if, in the unlikely event, their emissions are demonstrated to be non-photochemically reactive. However, this exemption is only applicable to the requirements of OAC rule 3745-21-07(G). A new HWOPL would still have to satisfy the BAT criteria in OAC rule 3745-31-05(A)(3) in order to obtain a permit

to install. The determination of what constitutes BAT does not take into account whether or not the emissions from a new source are non-photochemically reactive. The BAT determination is based on compliance with all applicable regulations, comparison to similar installations, and the cost-effectiveness values of the available control technologies.

Also considered are the social, economic and environmental impacts of the emissions. There may have been situations, however, where BAT determinations were found to be equivalent to compliance with OAC rules 3745-17-07, 3745-17-11 and 3745-21-07(G). Such determinations may have been made in the years shortly after the adoption of the permit to install rules when there was insufficient technical information. BAT determinations made in recent years are generally more stringent than compliance with OAC rules 3745-17-07, 3745-17-11 and 3745-21-07.

Test Methods and Compliance Demonstrations:

(15) Mass emissions from HWOPL's may consist of both particulates (due to condensed organic compounds and combustion products from gas/oil firing in the dryer and thermal/catalytic incineration units) and volatile organic compounds (VOC). Organic compound (OC) emissions from HWOPL's generally consist of VOC emissions and particulate resulting from any condensed organic compounds.

For HWOPL's equipped with thermal or catalytic incineration systems, only VOC testing and/or destruction efficiency testing should be necessary. No particulate testing should be necessary. For HWOPL's equipped with a cooler/condenser filtration system, particulate testing (Method 5) and VOC testing (Method 25) may be appropriate. For HWOPL's equipped with no controls, no VOC testing should be necessary as emissions can be calculated using material consumption data and the appropriate retention and carryover factors (see answer 21).

The VOC emission rate from HWOPL's should be measured using USEPA Test Method 25 or 25A, based on a consideration of the diversity of the organic species present and their total concentration, and on a consideration of the potential presence of interfering gases. VOC mass emissions are often determined concurrently with a determination of control equipment destruction/removal efficiency. When control devices are tested, USEPA EMC Guideline Document 11 provides guidance on when to use Method 25A in lieu of Method 25.

Test Method 25A is the preferred method for determining the VOC emission rate provided the VOC concentrations at the control device exhaust are 50 ppm, as carbon, or less. Information provided by the Graphic Arts Technical Foundation

(GATF) indicates that outlet VOC concentrations from properly operating oxidative control devices typically range between 5 - 20 ppm, as carbon, regardless of inlet concentrations. The GATF also cautions that attempting to calculate an expected outlet concentration using a linear destruction efficiency relationship and a measured or calculated inlet concentration may overstate the actual measured outlet concentration, as the destruction efficiency curve may not be linear.[1] If possible, a "pre-survey" to measure the actual outlet VOC concentration should be conducted before the actual emissions test to resolve any uncertainties about the use of Method 25A. Because Method 25A measures organic compound concentrations in real time, the effects of press adjustments, cleaning cycles, and temporary shutdowns on the VOC loading to the control device can be readily seen and evaluated.

After appropriate calculations from concentration and velocity data, both Method 25 and 25A report results in pounds of organic carbon per hour (i.e., only the carbon atoms in the organic species are quantified; the mass of oxygen, halogens, and other elements that comprise the VOC species are discounted). In either case, if test results must be reported in terms of pounds of VOC per hour, then a correction from the pounds of organic carbon value reported by Methods 25/25A is required. OAC Rule 3745-21-10(C)(7) details the conversion (also see answer 16). This conversion is only required when reporting outlet mass emissions; when determining destruction/removal efficiency, it is acceptable to compare pounds of organic carbon per hour at the inlet to pounds of organic carbon per hour at the outlet, without correcting to VOC.

If it is necessary to measure the particulate emission rate from HWOPL's, (see answers 3 and 6) USEPA Test Method 5 should be utilized. To demonstrate compliance with particulate limitations, only the front-half (filterable) catch of the Method 5 train is considered. (Note: based on engineering judgment, the Method 5 front-half catch for a HWOPL is essentially all organic material such as condensed ink oils.)

Other test methods or modifications to the above recommended test methods may be acceptable in special situations. Any questions concerning test methods and procedures for HWOPL's should be directed to the Emissions Monitoring and Testing Unit in the DAPC's Engineering Section.

(16) The weight of carbon from Method 25 or 25A test results may be converted to the weight of organic material by multiplying with either a typical ratio of 1.2 pounds of organic material per pound of carbon or an analytical ratio based on performing a carbon content analysis [using ASTM Standard E 191-64 (Apparatus for Microdetermination of Carbon and Hydrogen in Organic and Organo-Metallic Compounds)] and solvent content analysis [using OAC rule 3745-21-10(B)(4)] of

each ink and fountain solution and calculating a weighted ratio based on usage. Use of this ratio eliminates the need for expensive testing (Method 18) to determine the actual concentration of each chemical species in the discharge. In using this ratio, it is assumed that any uncontrolled emissions from a HWOPL are of the same composition as those in the liquid organic material used in the HWOPL. This assumption obviously does not hold in cases where the tested emissions are from the outlet of an incineration system used to control dryer emissions. The ratio should be higher in this case due to the presence of partial oxidation products. However, the DAPC will accept the 1.2 ratio, or the analytical ratio, in such cases since there is no reasonable testing alternative and since this ratio provides a conservative estimate.

The 1.2 ratio is derived from consideration of the average molecular weight of the predominant chemical species in ink oil compared to the average molecular weight of carbon in the same chemical species. This ratio is relatively common to the majority of chemicals in ink oil, which consist mainly of normal paraffin hydrocarbons in the C12 through C16 range.

(17) If the solvent in the web or any recirculated solvent-laden gases comes into direct contact with the flame from the burners in the dryer, then the liquid organic material is deemed to have contact with the flame. Although the language in OAC rule 3745-21-07(G)(1) refers to "... any <u>liquid organic material</u> or substance containing <u>liquid organic material</u> comes into contact with flame..." (emphasis added), and does not refer to the vapor phase of the liquid organic materials, it has historically been understood and employed in practice by both the Ohio EPA and industry that flame contact with such vapors would trigger the applicability of this rule. For example, a paper presented by James R. Blegen, Technical Coordinator, Resins and Plastics Division, Ashland Chemical Company, entitled "An Explanation of Ohio Air Pollution Hydrocarbon Regulations, AP-5-06 to AP-5-08 Covering Hydrocarbons and Photochemical Oxidants, Comments of the Ad-Hoc Committee of the National Paint and Coatings Association" (June 29, 1972), which was, and still is, widely used as a reference by Ohio EPA and industry, contains the following passage regarding paragraph (G)(1):

> "The regulation covers operations utilizing any organic solvent where, during the process, flame comes into contact with solvent or <u>solvent vapor</u>, or where baking, heat curing, or heat polymerizing takes place." (emphasis added)

Thus, flame contact with recirculated solvent-laden gases in the dryer will also subject such dryer to the requirements of paragraph (G)(1).

In practice, there appears to be two main types of dryers in use today. These are

high velocity hot air dryers with direct flame impingement on the web, and high velocity hot air dryers with recirculated air systems. This latter variety generally does not have flame contact with the web or with any solvent-laden recirculated gases. However, it is not possible to make a generalization that all recirculated air dryer systems do not have flame contact. Burner locations may be specifically designed by a manufacturer for a customer, or "pull-back" burners may be installed to allow for natural gas or fuel oil usage. Therefore, the position of the flame and the path of the recirculated air flow should be examined during HWOPL shutdown periods to determine whether or not the flame has direct contact with the recirculated solvent-laden gases.

The general rule of thumb for determining if any liquid organic material has been baked, heat-cured or heat-polymerized in the presence of oxygen, is that the applied material will redissolve in its original solvent. Reference to this procedure is found in the Air Pollution Engineering Manual (AP-40, Second Edition), page 865, which reads as follows:

> "A rough, not always conclusive, method to distinguish a baking process [baking, curing, or polymerizing] from a drying process in the field is to wipe the finished coating with the coating solvent or the liquid coating. If the coating on the product from the oven wipes off, not abrades off, the process was drying; if it does not wipe off, the process was baking."

Also, the above-mentioned paper presented by James R. Blegen offers the same guidance:

> "The proof as to whether the system is noncuring or nonpolymerizing under the influence of heat--and therefore exempt from limitation--is whether the system will redissolve in the original solvent."

HWOPL's use oils as the vehicle for the inks as opposed to the more conventional, low boiling point solvents used in other printing or coating operations. Flashing these oils off the substrate requires a higher temperature than many other coating operations. Air pollution control agencies have traditionally tried to separate evaporating and baking operations by evaluating the dryer temperature. This is not necessarily true for HWOPL's. Therefore, an evaluation of the drying process is necessary, as provided below.

The DAPC has contacted suppliers of inks, oils and fountain solutions and has

reached a general conclusion that these materials or their vapors are not baked, heat-cured, or heat-polymerized, in the presence of oxygen, as these terms are commonly known. Also, several tests have been conducted by the Engineering Section on printed material from different types of dryers employed in HWOPL's to determine if the heatset inks would redissolve by wiping them with cloth soaked with an oil used in the ink. All of the printed material to some degree was smudged by the oil. Thus, the field offices may assume that the liquid organic material or its vapors are not baked, heat-cured, or heat-polymerized in the presence of oxygen.

If there is any doubt as to this conclusion in a specific case, the field offices may perform a simple "smudge" test by obtaining a sample of one or more of the oils used in the ink material. (The Engineering Section also has some oils available for this test.) If the printed material smudges when gently rubbed with a soft cloth dipped into the oil(s), the liquid organic material has not been baked, heat-cured or heat-polymerized in the presence of oxygen.

Thus, assuming that the liquid organic material (or its vapors) used in a HWOPL is not baked, heat-cured, or heat-polymerized in the presence of oxygen, the applicability of OAC rule 3745-21-07(G)(1) rests on the question of whether or not there is direct flame contact with the liquid organic material or its vapors in the dryer.

(18) The test method for this demonstration is Method 18 and a cloud chamber test. To this date, there has been no satisfactory demonstration that organic material emissions from any HWOPL are not photochemically reactive. The USEPA has reviewed a study by Battelle Memorial Institute on this matter. (Copies of the USEPA's complete response to this study are available by request from the Engineering Section.) Also, a USEPA funded study performed by the Statewide Air Pollution Research Center was similarly inconclusive concerning the photochemical reactivity of heatset printing oils. The DAPC believes that it is doubtful that any regulated entity could show eligibility for this exemption. Until such a demonstration is made and the USEPA adds the organic material emissions from HWOPL's to its list of organic compounds with negligible photochemical reactivity (see answer 11), this exemption provision cannot be used for HWOPL's.

(19) Normally, capture efficiency testing of HWOPL’s is not necessary. The printing industry has stated that capture testing of HWOPL’s in the past has yielded very inaccurate results, causing compliance problems with overall reduction requirements in past permits. This is caused in part by the ink solvents being retained in the web and fugitive emissions from fountain solution trays and blanket wash systems. Neither the draft CTG document entitled “Control of Volatile Organic Compound Emissions from Offset Lithographic Printing” (September, 1993) or the ACT document entitled “Offset Lithographic Printing” (June, 1994)

state that capture efficiency testing is required for a heatset web offset lithographic printing press.

USEPA has stated in recent correspondence that capture efficiency may be assumed to be 100 percent for the VOC's not retained by the substrate or emitted as fugitive emissions (see retention and carryover factors in answer 21), provided that the press dryer maintains a negative pressure within the pressroom and the dryer exhausts to a control device.[2] In addition, USEPA has recommended that negative dryer pressure be demonstrated with either a differential pressure gauge or a smoke test(s).[3]

If negative pressure in the dryer cannot demonstrated, capture efficiency testing using Methods 204 through 204F, as specified in 40 CFR, Part 51, Appendix M, may be required. The operator may request an alternative method or procedure for the determination of capture efficiency in accordance with the USEPA's "Guidelines for Determining Capture Efficiency," dated January 9, 1995. The Ohio EPA will consider the request, including an evaluation of the applicability, necessity, and validity of the alternative, and may approve the use of the alternative if such approval does not contravene any other applicable requirement.

(20) The operator of a HWOPL can demonstrate that the pressure inside the dryer is always negative relative to the static pressure of the pressroom by either of the following methods:

a. By using a differential pressure gauge so that an inlet of the gauge is within the dryer and the other inlet is open to the ambient air in the pressroom. The differential pressure gauge may be a liquid column gauge or may be a mechanical type gauge. The differential pressure gauge shall be properly leveled and zeroed according to the manufacturer's instructions. If a mechanical type gauge is used, it should be calibrated according to the manufacturer's instructions against a liquid column gauge. (If a liquid column gauge is used, no calibration is necessary). The gauge should measure a pressure differential of at least 0.007 inches of water column whenever the press is operating to ensure that air is entering the dryer through all of the dryer's openings (excluding the exhaust stack). If a pressure gauge is to be permanently installed on the dryer, the location of the pressure tap within the dryer should not be modified without first consulting with the dryer manufacturer/installer. This is important since the manufacturer/installer may have used the pressure differential to set the exhaust rate for the dryer to ensure that the VOC concentration within the dryer remains below 25 percent of the lower explosive limit.

b. By using smoke tubes, plastic flow indicating strips or other flow indicating

devices approved by the field office in consultation with the Engineering Section to demonstrate that air flows into the dryer at all openings in the dryer (excluding the exhaust stack). All points measured with such devices should indicate airflow into the dryer.

It is recommended that an operator of a HWOPL demonstrate negative pressure in the dryer upon initial start-up of a new source and whenever proper dryer operation is questioned due to stack or dryer modification, observation, or similar situation.

(21) In lieu of capture efficiency testing, USEPA recognizes the following emission factors for calculating VOC emissions from a heatset web offset lithographic printing press. These factors, which are included in the draft CTG (Sept., 1993) and ACT (June, 1994) documents include:

a. 20 percent of VOC's in heatset inks are retained by the substrate, 80 percent goes to the dryer and are ducted to a control device (assuming a device is present);

b. 70 percent of the VOC's from alcohol substitute(s) in fountain solution are captured into the press dryer and are ducted to a control device (assuming a device is present), 30 percent are fugitive; (Note: if alcohol is used in the fountain solution, assume all alcohol is fugitive);

c. 40 percent of VOC's from cleaning solvents used with automatic blanket washing equipment (provided that the vapor pressure of the cleaning solvent is less than 10 mm Hg at 20 degrees Celsius) are captured into the press dryer and are ducted to a control device (assuming a device is present), 60 percent are fugitive; and

d. 50 percent of the cleanup solvent for hand wash cleanup operations is retained in the cloths and 50 percent is emitted as fugitive, if the cleanup solvent has a vapor pressure of 10 mm Hg or lower at 20 degrees Celsius (68 deg. F) and the cloths are stored in closed containers.

Note: Assume 100 percent of the cleanup solvent used in automatic blanket washing systems or hand wash operations is emitted as fugitive if the cleanup solvent vapor pressure is greater than 10 mm Hg at 20 degrees Celsius (68 deg. F).

The total overall emission rate is a combination of fugitive emissions and the controlled emission rate from the control device or dryer stack, if no control

device is present. The controlled emission rate is calculated using the above factors for OC's ducted to the dryer and the destruction efficiency (DE) of the control device. See Attachment I for more information.

(22) Generally, emission testing of a source is required to be conducted under maximum operating conditions. For a HWOPL, this would mean operating at fastest press speed, widest paper width, and "full coverage" (i.e., maximum usage of ink, fountain solution, coatings and cleanup solvents). However, printing under "full coverage" conditions would totally ignore print quality and would result in a large amount of unsalable product being generated at significant cost to the company. In addition, running under such conditions would be artificial and not represent normal operations. This situation is recognized in the performance testing requirements of the MACT standard for rotogravure/flexographic printing, 40 CFR, Part 63, Subpart KK which states that testing can be conducted "under normal operating conditions."

Printing presses are operated with a wide variation in press speed and ink coverage depending on the specific job being printed. Even when the press is running a constant job, variations in press speed (with accompanying changes in ink and fountain solution consumption) and periodic shutdowns for press cleaning or web breaks will occur as the press operators adjust the press to achieve and maintain the desired print quality. Consequently, the printing process is a non-steady-state, highly variable operation in terms of material input and consumption that results in fluctuations in airflow and VOC loading to the control system. When multiple presses are controlled by a common control system, scheduling production on all presses so that maximum VOC loading to the control device is maintained for a period long enough to conduct three 1-hour test runs is extremely difficult, if not, impossible.

To address these concerns, the Engineering Section strongly recommends the field office conduct a pre-test meeting with the company prior to the emission testing date. The field office should request the company propose an operating scenario for the press(es) being tested which is representative of actual operating conditions and VOC input rate to the control device. In preparing their operating scenario for the compliance test, a company should strive to minimize downtime and run as many presses as practicable. If necessary, historical production records from the company should also be consulted to identify average coverage rates and press speeds or ink consumption rates, run times, and time of intermittent events such as press cleaning, web breaks or similar shutdown situations.

It is further recommended that sampling (during an emissions test) not be stopped for events such as cycling of automatic blanket washing systems, press speed

variations, web breaks (if short in duration) or other short-term events in which the print quality is being checked. These conditions should be agreed upon between the company and the field office personnel prior to the actual test date.

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[1] Memorandum from Gary Jones, (Graphic Arts Technical Foundation) to Richard Carleski (Ohio EPA) dated October 29, 1998.

[2] Telephone conversation between Richard Carleski (Ohio EPA) and David Salman (U.S. EPA) on January 31, 1997.

[3] Letter to Patrick Haines (Ohio EPA) from George Czerniak (USEPA) dated September 17, 1997.

March 16, 1990

JO/TK/PH/RC (reviewed & revised June 15, 1999)

Attachment I

Table 1: Possible HWOPL Conditions and Related Organic Material Emission Requirements Under OAC Rule 3745-21-07(G)

Direct Flame Contact Dryer? [a]	Any Photochemically Reactive Materials Used on Press? [b]	Organic Material Emission Requirement [c]
yes	yes	stack emissions + fugitive emissions ≤ 8/40 *
yes	no	stack emissions ≤ 3/15 *
no	yes	stack emissions + fugitive emissions ≤ 8/40 *
no	no	no limit

[a] If any solvent on the web or any recirculated solvent-laden gas comes into direct contact with a burner's flame in the dryer, the dryer is a direct flame contact dryer. This situation is expected to be rare with present dryer design.

[b] Includes ink, fountain solution and cleanup materials. The definition of "photochemically reactive material" is based on OAC rule 3745-21-01(C)(5). Based on information obtained during the preparation of this guide, it has been determined that the inks and fountain solutions normally used in HWOPL's are not photochemically reactive materials. If any material has an exemption pursuant to OAC rule 3745-21-07(G)(9)(c) through (G)(9)(g), as explained in answer 11, that material's emissions are not included in determining compliance with organic material emissions requirements.

[c] The organic material emission requirements pertain to the requirements under OAC rule 3745-21-07(G). Additional information is provided below under Abbreviations and Emissions.

Abbreviations:

8/40 = 8 lbs/hr and 40 lbs/day

3/15 = 3 lbs/hr and 15 lbs/day

* = or other limit based on 85% overall emission reduction (with 90% destruction efficiency for any incineration equipment)

Emissions:

Stack Emissions, S, (lbs/hr) from dryer control device or dryer stack (if uncontrolled) are:

$$S = (1 - DRE)[\ 0.8\ (P) + A_d\ (FS) + B_d\ (CS)\ ]$$

Fugitive emissions, F, (lbs/hr) from a press are:

$$F = A_f\ (FS) + B_f\ (CS)$$

Total emissions from press = S + F

where

DRE = destruction or removal efficiency of control device, expressed as a decimal (i.e., 0.95)

P = (ink usage rate, lbs/hr) X (ink VOC content, % by wt.)

FS = (fountain solution usage rate, gal/hr) X (fountain solution VOC content, lbs VOC/gal)

CS = (cleanup solvent usage rate, gal/hr) X (cleanup solvent VOC content, lbs VOC/gal)

A_d = mass fraction of fountain solution VOC routed to dryer and control device (if present);
for alcohol substitutes, $A_d = 0.7$
for alcohol fountain solutions, $A_d = 0.0$

A_f = mass fraction of fountain solution VOC emitted as fugitive;
for alcohol substitutes, $A_f = 0.3$
for alcohol fountain solutions, $A_f = 1.0$

B_d = mass fraction of cleanup solvent routed to dryer and control device (if present);
for automatic blanket washing systems, $B_d = 0.4$ (if solvent vapor pressure < 10 mm Hg at 20 deg. C (68 deg. F)); for higher vapor pressure solvents, $B_d = 0.0$

for hand wash cleanup operations, $B_d = 0.0$

B_f = mass fraction of cleanup solvent emitted as fugitive;
for automatic blanket washing systems, $B_f = 0.6$ (if solvent vapor pressure < 10 mm Hg at 20 deg. C (68 deg. F)); for higher vapor pressure solvents, $B_f = 1.0$

for hand wash cleanup operations, $B_f = 0.5$ (if solvent vapor pressure < 10 mm Hg at 20 deg. C (68 deg. F) and used rags are stored in closed containers); for higher vapor pressure solvents, $B_f = 1.0$