## PERMIT APPLICATION GUIDE FOR FACILITIES WITH COATING/PAINTING OPERATIONS

Applicants overwhelmed by permit application details for facilities with coating/painting operations may assess the emissions by review of this guide and avoid common mistakes. The guide should simplify the task of completing permit applications for facilities with this type of operation.

### DATA YOU WILL NEED TO COMPILE INITIALLY:

a. maximum anticipated hourly and annual usage of each coating material
b. building dimensions: length, width, height (emissions released within a building are not considered controlled but may have modeling significance)
c. heat input capacity of each large gas heater or oven used in the process (note: this does not include comfort space heaters)
d. composition of each coating product, usually from Material Safety Data Sheets
e. stack data: height, diameter, temperature, and flowrate (height is height above ground level; diameter is diameter at discharge; temperature is an average temperature; such as $70^{o}$ for non-heated processes; and flowrate is normally actual cubic feet per minute. Flowrates are discussed in a later section.)
f. maximum anticipated welding electrode usage (if arc welding conducted)
g. sandblasting: hourly and annual abrasive usage; abrasive type

### PROVIDE COMPLETE INFORMATION FOR THE FACILITY

Another common mistake is for an applicant to send in an incomplete application, a few Material Safety Data Sheets, and little else. Failing to properly identify and calculate emissions is a guarantee of slow processing and frequent Enforcement referrals. Poorly prepared applications with incomplete or insufficient information will limit operators to only those volumes of products shown in their submissions.

### DESCRIBE THE PROCESS AT YOUR FACILITY

Process description begins with a discussion of the equipment and a flow diagram of the processes at the facility. Describe the equipment used and draw a process flow diagram of process points. Process points are known pollution emitting operations that utilize various methods (spray, roll, dip by hand or machine) to apply materials to surfaces. Provide rated equipment capacities and maximum process rates at emissions points and identify whether continuous or batch operations. Provide hours of equipment operation each year. Include the discharge parameters in the process description (stack height, diameter, temperature, and exhaust flow rates). Flow rate determinations seem to challenge applicants the most. A proper process description explains coating/painting activities just enough to identify air pollution emitting operations and will be less detailed as would be provided to design engineers, financial planners, etc.

## CALCULATE EMISSIONS AT THE FACILITY

In permit language, facility status classification is based upon potential emission rates. Commonly, applicants mistake or confuse potential and actual emissions, but the two are related. The potential to emit (PTE, potential emissions) means the maximum potential of a facility to emit criteria pollutants or hazardous air pollutants (HAP). Potential is based on equipment capacities but may be influenced by process bottlenecks such as batch operation or other documented mechanical limits. Actual emissions are based on control devices or accepted hourly limitations which reduce the potential emissions into the atmosphere. That's good because it's the air we breathe.

### Potential Emissions Calculations

Permits reflect both short term (hourly) and long term (annual). Maximum hourly emissions are based on the maximum hourly performance or production multiplied by a known related emission factor. Identifiable process bottlenecks which limit production or equipment operation and affect annual emissions will become part of a permit.

### Actual Emissions Calculations

Actual emissions are derived from the facility's reduced PTE (potential emissions). Factoring control devices, accepted hourly limits, and accepted production limits results in actual emissions calculated for pollutants such as particulate matter (PM). Control devices and equipment have efficiencies expressed as a percentage of pollutant reduced. To avoid an unduly restrictive permit for the facility if only past rates are known, a reasonable safety factor should be applied to possibly account for increasing or fluctuating future business and production.

> Example 1:
> Emissions of criteria pollutants (such as VOC) and HAP identified at each process point are individually calculated (hourly and annually). To calculate the hourly rate, multiply the known emission factor for each pollutant by the production rate or capacity of the process point. To calculate the annual rate, multiply the short term emission rates by the maximum annual operation hours of each process point. VOC emissions are calculated for each process point. The VOC emitted at all the process points are then summed facility-wide.
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> Example 2:
> A painting operation may be able to spray 1.5 gallons per hour of paint; with 8,760 hours in the year, maximum usage would be 13,140 gallons. However, facilities often accept a lower usage limit (for example, 5,000 gallons) to stay below an emission thresholds at which some regulatory requirements become applicable. Since those requirements may include Maximum Achievable Control Technology, it is wise to back-calculate the operational levels which would trigger additional procedures and capital expenditures. A facility which has never approached that limit would not feel restricted by it.

## GENERAL INFORMATION

FORMS: Log onto www.deq.state.ok.us and select "Air Quality", then "Forms" and next "Air Forms" to obtain the Minor Source Application forms.

FEES: Fees depend on the facility classification type determined from potential emission rates. Therefore it is essential to determine potential emission rates in order to properly calculate and pay the correct fees.

EMISSION FACTORS: log onto www.epa.gov/ttn/ and go to "CHIEF", emission factor site "AP-42 5th Edition by Section". We advise applicants read the index or section headings to AP-42 first to find which operations have readily-available emissions factors that can be used for their facility.

STACK FLOWS: a few suggestions which may help…

- OSHA requires paint booth face velocity to be at least 100 feet per minute. For example, a paint booth with a 6' × 8' opening should have a discharge rate of at least 4,800 cubic feet per minute.
- Fire codes require 5 to 6 air exchanges per hour for buildings handling flammable materials. A building that is 40 feet wide, 25 feet tall, and 100 feet long has a volume of 100,000 cubic feet. If this building has 8 roof fans, each fan should discharge 1,250 cubic feet per minute (6 exchanges × 100,000 cubic feet divided by eight fans divided by 60 minutes per hour).
- For natural gas combustion: expect 13.2 standard cubic feet exhausts per cubic foot of natural gas fuel, then convert volumes to actual; expect stack temperatures in the range of 400-600$^{o}$F.

GENERIC SPECIFICATIONS: The best way to gain flexibility in permitting is to establish a "supercoating" or generic set of specifications for paints, primers, inks, lacquers, etc. A material safety data sheet (MSDS) for each product discloses physical properties (e.g. – density, composition or weight percentages of components). You may compare them to determine the generic specification. The limit may be set by any product among all others with the greatest amount of any single component (pounds per gallon). This is then used to set the maximum levels of emission (e.g. – solids, VOCs) and multiplied by the total usage volume of all the products used. In some cases, you could have multiple supercoatings, i.e., one for paints, one for primers, etc.

Spray paints from aerosol cans should be in a separate supercoating where applicable.

## REGULATORY THRESHOLDS TO OBSERVE

Regulatory requirements may be triggered if a facility reaches certain emissions levels or is in certain areas.

- Paint operations: 100 lb/day volatile organic compounds emitted;
- Tulsa County: 10 TPY (OAC 252:100-39-46(h))(Note: acetone does not count in that total);
- Hazardous Air Pollutant (HAP) thresholds:
    - 10 TPY of any one HAP
    - 25 TPY total HAPs
- 100 TPY any criteria pollutant (including volatile organic compounds or paint solvents)

If you exceed any of these thresholds, there are requirements for additional analyses and sometimes additional air pollution controls. There is a common misconception that someone cannot exceed these levels; that is not correct. There are, however, consequences for exceeding these thresholds that you may or may not find acceptable, depending on the circumstances.

## SAMPLE CALCULATIONS

The procedure begins with an MSDS. List out the product density and approximate the hourly and annual usage. Multiply the density times hourly/annual usage times the weight percent for each component. Coating products are typically reported as percentages by weight, although occasionally volume percentages are reported. Our calculations depend on weight.

Sometimes, you may assume 50% transfer efficiency (meaning half of all solids stay on your product). Particulate emissions are be further reduced by the control efficiency of any filters controlling particle emissions in the spray area. Transfer efficiency is principally a function of the geometry of the pieces being sprayed, so using 50% is discouraged if more accurate information is available.

For dip coating, roll coating, or similar operations (other than spraying), emissions of solid components will be minimal and can be left off.

Suggestion: it has been our experience that these are easier to keep organized if the components are in alphabetical order.

The following table demonstrates this method for a typical coating product. Note that each product has to be analyzed in an "as applied" state; that is, if the product has two or three constituents that must be mixed before application, or if the product is thinned by addition of a solvent before application, the characteristics of the mixed or thinned product must be used in the analysis.

| Product | Density ppg | Hourly Usage Gallons | Annual Usage Gallons | Chemical Constituent | Weight Percent | Emissions lb/hr | Emissions TPY |
|---|---|---|---|---|---|---|---|
| Acme Coating XYZ | 10.96 | 1.5 | 5000 | Total VOC | 42% | 6.91 | 11.51 |
| | | | | 1,2,4-trimethyl benzene | 10% | 1.64 | 2.74 |
| | | | | aluminum | 10% | 0.08 | 0.14 |
| | | | | aromatic hydrocarbons | 20% | 3.29 | 5.48 |
| | | | | butyl acetate | 35% | 5.75 | 9.59 |
| | | | | ethyl benzene * | 5% | 0.82 | 1.37 |
| | | | | methyl ethyl ketone | 1% | 0.16 | 0.27 |
| | | | | propylene glycol methyl ether acetate | 10% | 1.64 | 2.74 |
| | | | | Xylene * | 10% | 1.64 | 2.74 |

* Hazardous Air Pollutant (HAP).

Note that aluminum has been reduced by 50% to account for retention on the product and a further 90% to account for filter control efficiency. Although the components of the coating product that one might normally consider to be VOC add to 91%, VOC is established as only 42%. This is because each component is typically listed with a content range up to a maximum percentage. For conservative analysis of an individual component, we always assume the highest content or percent in its range.

**DEVELOPING "SUPERCOATINGS" FOR PERMITS**

Again, "supercoating" is a set of generic specifications regarding the composition of paints, inks, lacquers, varnishes, and other surface coating materials. Specifying a supercoating in a permit provides the maximum flexibility for an operator while minimizing the potential for having to modify permits. The procedure is designed to conservatively derive a worst-case set of conditions. Logically, if the worst-case conditions are in compliance with the applicable standards, then all other conditions will be in compliance, also.

Any given material may have various components that are subject to a federal NSPS or NESHAP regulation and must be broken down by relative percentages. Once isolated, each criteria pollutant and each HAP can be properly calculated and a proper determination made. Permit applications should include a stack of material safety data sheets that state the product density and proportion (or proportion range) of each hazardous component. Frequently, products will be listed as "trade secret." Occasionally, the percentage of a single solvent will exceed the percentage stated to be volatile.

There are 4 steps to develop a supercoating.

1. Divide the MSDSs into categories: topcoats, primers, solvents, etc. Solvents include those used in surface preparation or in equipment clean-up. If a specific solvent or amount of solvent is dedicated to mixing with a particular coating product, its quantity may be grouped with that product to accurately reflect as-applied values, but account for it once.

2. For each category, calculate the composition of each component on a pounds per gallon (ppg) basis. When a range is specified, always use the high end of the range.

3. Prepare a table of components and ppg compositions. It is helpful to do them in alphabetical order.

4. Pick the highest ppg number from each coating.

***Doing this procedure, the sum of components will exceed 100%, as noted in the above discussion of the single product analysis.***

NOTE: the abbreviations "MEK" and "MIBK" mean methyl ethyl ketone and methyl isobutyl ketone, respectively. MEK has been de-listed by the EPA and is no longer considered a HAP.

Essentially all VOCs in the total of paints and primers applied are emitted. Solids would be handled almost identically except that both a transfer (retention) efficiency and control efficiency must be factored in. As discussed earlier, the amount of solids transferred to or retained on the product is a function of the product's geometry, and must be estimated for each specific situation. Commonly, paint booths have filters in the range of 95-99% efficiency for PM emissions control, but your filter manufacturer's data should list accurate information about rated efficiencies for each type of filter medium option.

EXAMPLE SUPERCOATING: A widget factory uses four basic paints: red, blue, black, and yellow. Specifications for each paint are listed below.

| **Red** | **Blue** | **Black** | **Yellow** |
|---|---|---|---|
| 8 ppg | 9 ppg | 10 ppg | 12 ppg |
| 47% total VOC | 52% total VOC | 30% total VOC | 40% total VOC |
| 5-10% MEK | 20% MEK | 15% acetone | 12% MEK |
| 5-15% xylene | 15% toluene | 15% xylene | 18% MIBK |
| 10-15% MIBK | 30% MIBK | 5% butyl cellosolve | 5-10% toluene |
| 10% toluene | | | 5-10% xylene |

FIRST: Make a table, preferably in alphabetical order, showing lb/gal concentrations of all components.

| **Pollutant** | **Red** | **Blue** | **Black** | **Yellow** | **Highest After Rounding** |
|---|---|---|---|---|---|
| Total VOC | 3.76 | 4.68 | 3.00 | 4.80 | |
| Acetone | -- | -- | 1.50 | -- | |
| Butyl cellosolve | -- | -- | 0.50 | -- | |
| MIBK | 1.20 | 2.70 | -- | 2.16 | |
| Toluene | 0.80 | 1.35 | -- | 1.20 | |
| Xylene | 1.20 | -- | 1.5 | 1.20 | |

Next, compare products and select the highest concentration of each pollutant (shown in bold). Enter that amount into the column marked "highest."

| Pollutant | Red | Blue | Black | Yellow | Highest |
|---|---|---|---|---|---|
| Total VOC | 3.76 | 4.68 | 3.00 | **4.80** | 4.80 |
| Acetone | -- | -- | **1.50** | -- | *** |
| Butyl cellosolve | -- | -- | **0.50** | -- | 0.50 |
| MEK | **1.80** | -- | -- | -- | 1.80 |
| MIBK | 1.20 | **2.70** | -- | 2.16 | 2.70 |
| Toluene | 0.80 | **1.35** | -- | 1.20 | 1.35 |
| Xylene | 1.20 | -- | **1.50** | 1.20 | 1.50 |

Acetone is excluded from the definition of VOC and is not a toxic HAP nor is MEK. Therefore, don't include them as a "supercoating" component.

Amounts listed in column "highest" may now be rounded up slightly to allow some flexibility, but only if they do not cause the facility to exceed any of the thresholds discussed earlier. The generic "supercoating" will have the following specifications. Any coating that meets these specifications will be in compliance with the permit.

| Pollutant | Concentration lb/gal |
|---|---|
| Total VOC | 5.0 |
| Butyl cellosolve | 0.6 |
| MIBK | 3.0 |
| Toluene | 1.5 |
| Xylene | 1.6 |

Suppose now that maximum paint usage is 3 GPH and 10,000 GPY

A simplified calculation of emissions rates follows.

| Pollutant | Concentrations lb/gal | Hourly usage gallons | Annual usage gallons | Emissions | |
|---|---|---|---|---|---|
| | | | | lb/hr | TPY |
| Total VOC | 5.0 | 3.0 | 10,000 | 15.00 | 10.00 |
| Butyl cellosolve | 0.6 | | | 1.80 | 3.00 |
| MIBK | 3.0 | | | 9.00 | 15.00 |
| Toluene | 1.5 | | | 4.50 | 7.50 |
| Xylene | 1.6 | | | 4.80 | 8.00 |

Permit conditions are now appropriate limiting the facility to 3 GPH (24-hour average) and 10,000 gal/yr of paints with the following limitations of solvent content. The operator will be required to keep records of paint usages and MSDSs for each paint used.

One closing thought: you may wonder why components should be stated as ppg instead of weight percentages. If an initial coating with a density of 12 ppg and 10% by weight xylene is replaced by a coating with a density of 8 ppg and 12.5% xylene, the first coating has 1.2 ppg xylene while the replacement has 1.0 ppg. Stating limits in terms of 10% by weight would result in those limits being violated by an emissions reduction.

## HELPFUL DATA

The following emission factors are based on EPA's "Compilation of Air Pollutant Emission Factors," better known as "AP-42." AP-42 is periodically updated, so limits based on these factors may become out-of-date. It may be to your advantage to include a safety factor on calculations provided that the resultant emissions do not exceed any level of significance such as a regulatory limit or a major source threshold.

A. Natural Gas Combustion Emissions Factors

| Pollutant | Emission Factor, lb per million cubic feet |
|---|---|
| NOx | 100 |
| CO | 84 |
| VOC | 5.8 |
| Particulate Matter | 7.6 |
| Sulfur Dioxide | 0.6 |

B. Welding Emissions

| Pollutant | Emission Factor, lb per thousand pounds electrode used |
|---|---|
| PM | 8.16 |
| Chromium | 2.53 |
| Chromium VI | 1.88 |
| Cobalt | 0.001 |
| Manganese | 2.32 |
| Nickel | 1.71 |
| Lead | 0.162 |

C. Sandblasting

- Outdoors using sand: 13 lbs per 1,000 lb abrasive used
- enclosed with baghouse: 0.69 lbs per 1,000 lb abrasive
- grit: 24% of sand
- steel shot: 10% of sand

HAZARDOUS AIR POLLUTANTS

| | |
|---|---|
| acetaldehyde | styrene |
| acetamide | styrene oxide |
| acetonitrile | 2,3,7,8-tetrachlorobenzo-p-dioxin |
| acetophenone | 1,1,2,2-tetrachloroethane |
| 2-acetylaminofluorine | tetrachloroethylene (perchloroethylene) |
| acrolein | titanium tetrachloride |
| acrylamide | toluene |
| acrylic acid | 2,4 toluene diamine |
| acrylonitrile | dibutyl phthalate |
| allyl chloride | p-dichlorobenzene |
| 4-aminobiphenyl | 3,3-dichlorobenzidine |
| aniline | dichloroethyl ether |
| o-anisidine | 1,3-dichloropropene |
| asbestos | dichlorvos |
| benzene | diethanolamine |
| benzidine | N,N-diethyl aniline |
| benzotrichloride | diethyl sulfate |
| benzyl chloride | 3,3-dimethoxy benzidine |
| biphenyl | dimethyl aminor azobenzene |
| bis(2-ethylhexyl) phthalate - DEHP | 3,3-dimethyl benzidine |
| bis(chloromethyl)ether | dimethyl carbamoyl chloride |
| bromoform | dimethyl formamide |
| 1,3-butadiene | 1,1-dimethyl hydrazine |
| calcium cyanamide | dimethyl phthalate |
| caprolactum | dimethyl sulfate |
| captan | 4,6-dinitro-o-cresol and salts |
| carbaryl | 2,4-dinitrophenol |
| carbon disulfide | 2,4-dinitrotoluene |
| carbon tetrachloride | 1,4-dioxane (1,4-diethyleneoxide) |
| carbonyl sulfide | 1,2-diohenyl hydrazine |
| catechol | epichlorohydrin |
| chloramben | 1,2-epoxybutane |
| chlordane | ethyl acrylate |
| chlorine | ethyl benzene |
| chloroacetic acid | ethyl carbamate (urethane) |
| 2-chloroacetophenone | ethyl chloride (chloroethane) |
| chlorobenzene | ethylene dibromide (dibromoethane) |
| chlorobenzilate | ethylene dichloride (1,2 dichloroethane) |
| chloroform | ethylene glycol |
| chloromethyl methyl ether | ethylene imine (aziridine) |
| chloroprene | ethylene oxide |
| cresols/cresylic acid (mixed isomers) | ethylene thiourea |
| o-cresol | ethylidine dichloride (1,1-dichloroethane |
| m-cresol | formaldehyde |
| p-cresol | heptachlor |
| cumene | hexachlorobenzene |
| 2,4-D salts and esters | hexachlorobutadiene |

| | |
|---|---|
| DDE | hexachlorocyclopentadiene |
| diazomethane | hexachloroethane |
| dibenzofurans | hexamethylene-1,6-diisocyanate |
| 1,2-dibromo-3-chloropropane | hexamethylphosphoramide |
| maleic anhydride | hexane |
| methanol | hydrazine |
| methoxychlor | hydrochloric acid |
| methyl bromide (bromomethane) | hydrofluoric acid |
| methyl chloride (chloromethane) | hydrogen sulfide |
| methyl chloroform (1,1,1-trichloroethane) | hydroquinone |
| methyl ethyl ketone (2-butanone) DELISTED 12/05 | isophorone |
| methyl hydrazine | lindane (all isomers) |
| methyl iodide (iodomethane) | 2,4-toluene diisocyante |
| methyl isobutyl ketone (hexanone) | o-toluidine |
| methyl isocyante | toxaphene |
| methyl methacrylate | 1,2,4 trichlorobenzene |
| methyl tert-butyl ether | 1,1,2-trichloroethane |
| 4,4-methylene bis(2-chloroaniline) | trichloroethylene |
| methylene chloride (dichloromethane) | 2,4,5-trichlorophenol |
| methylene diphenyl diisocyanate (MDI) | 2,4,6-trichlorophenol |
| 4,4-methylenedianiline | triethylamine |
| naphthalene | trifluralin |
| nitrobenzene | 2,2,4-trimethyl pentane |
| 4-nitrobiphenyl | vinyl acetate |
| 4-nitrophenol | vinyl bromide |
| 2-nitropropane | vinyl chloride |
| N-nitroso-N-methylurea | vinylidine chloride |
| N-nitrosodimethylaniline | xylene - mixed isomers |
| N-nitrosomorpholine | o-xylene |
| parathion | m-xylene |
| pentachloronitrobenzene | p-xylene |
| pentachlorophenol | antimony compounds |
| phenol | arsenic compounds |
| p-phenylenediamine | beryllium compounds |
| phosgene | cadmium compounds |
| phosphine | chromium compounds |
| phosphorus | cobalt compounds |
| phthalic anhydride | coke oven emissions |
| polychlorinated biphenyls | cyanide compounds |
| 1,3-propane sultone | glycol ethers |
| beta-propiolactone | lead compounds |
| propionaldehyde | manganese compounds |
| propoxur (Baygon) | mercury compounds |
| 1,2-propylene dichloride | fine mineral fibers |
| propylene oxide | nickel compounds |
| 1,2-propylenimine | polycyclic organic matter |
| quinoline | radionuclides (including radon) |
| quinone | selenium compounds |

Visit EPA at http://www.epa.gov/ttn/atw/orig189.html for more information.