

Guidelines for Calculating VOC Emissions from Lithographic Printing Operations - December 2019

The following methodology should be used to calculate VOC emissions from lithographic printing operations. This methodology has been developed by the SCAQMD in cooperation with the Printing Industries Association.

Lithographic Inks

$$\text{Emissions} = Q * EF * (1 - RF) * (1 - CE_{\text{overall}}) \quad \text{Eq. (1)}$$

where:

- Emissions = Emissions of volatile organic compounds (lbs)
Q = Throughput (quantity of ink applied in lbs or gallons)
EF = Emission Factor (lb/lb ink or lb/gal)
RF = Retention factor (ink type specific in decimal)
CE_{overall} = Overall Efficiency of Control System (decimal)

- (1) User may refer to the product Material Safety Data Sheet (MSDS) to determine the emission factor (EF) based on volatile organic compounds (VOC) content of the ink. This may include, but not limited to, one or more of the following:
- a) Volatile organic compounds (VOC)
 - b) Lithographic oil content (LOC) such as:
 - Petroleum-based oils
 - Vegetable-based oils
 - Oxidizing oils
 - Middle distillates
 - Linseed oil
 - White mineral oil
 - Other oils

If MSDS provides both VOC and LOC percentages or fractions, use the higher number for calculation purposes. **NOTE:** Unit of EF must be consistent with that of ink applied (Q), i.e., EF in weight fraction of lb/lb for Q in pounds.

- (2) Depending on type of inks, the following retention factors are applicable for equation (1):

HEATSET INKS: RF = 0.20

NON-HEATSET INKS: RF = 0.95

NOTES:

- (1) RF is applicable to Conventional Products that contain VOC and/or LOC;
- (2) RF is not applicable to the following:
 - a. Printing inks in Flexography, Gravure, Screen, Letterpress, and Inkjet;
- (3) Overall efficiency (CE_{overall}) of a control system is defined as:

$CE_{overall} = CE_{cap} * CE_{des} \qquad \text{Eq. (2)}$
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where:

CE_{cap} = Capture Efficiency of Control System (fraction)

CE_{des} = Destruction Efficiency of Control Equipment (fraction)

In general, control system performance is tested to determine capture and control efficiencies. In the absence of project-specific source tested capture efficiency results, a default **capture efficiency** of 99.5% (CE_{cap} = 0.995) is allowed for **heatset materials only**. Any deviation from this default capture efficiency must be substantiated with supporting documentation.

Assumptions for Other Lithographic Printing Ink Operations

Fountain solutions and blanket/roller washes do not possess the same characteristics as lithographic inks; therefore, retention factors are not applicable to emissions from the use of these materials. However, in the absence of a specific source test, a carry-over factor is allowed as follows:

- ◆ 70% of emissions from **fountain solution** are allowed as default carry-over to the **heat set dryer**, provided that the dryer is vented to the afterburner. The VOC emissions from the use of fountain solutions (E_{fountain}) are calculated using the following equation:

$E_{fountain} = Q * EF * [1 - (0.70 * CE_{overall})] \qquad \text{Eq. (3)}$

- ◆ 40% of emissions from **blanket/roller washes** are allowed as default carry-over to the **heat set dryers only** for **automatic wash operations**, provided that the dryers are vented to afterburners. The VOC emissions from the use of blanket/roller washes (E_{wash}) are calculated using the following equation:

$E_{wash} = Q * EF * [1 - (0.40 * CE_{overall})] \qquad \text{Eq. (4)}$

where:

E_{fountain} = Emissions of VOC (lbs) from the use of fountain solutions

- E_{wash} = Emissions of VOC (lbs) from the use of blanket/roller washes
- Q = Throughput (quantity of material applied in lbs or gallons)
- EF = Emission factor (lb/lb or lb/gal)
- $C_{overall}$ = Overall Efficiency of Control System (decimal)

STEPS TO REPORT EMISSIONS

Example: One web fed heat set printer used 4000 pounds of black ink (VOC = 0.375 lb/lb per MSDS); 20 gallons fountain solution (VOC = 0.8 lb/gal per MSDS); and 10 gallons universal blanket/roller wash with an automatic cleaning system (VOC = 6.7 lb/gal per MSDS) in this reporting period. The operation is vented to a control system operating at 99.5 % overall.

Emissions for the black ink are calculated below using Eq. (1):

$$E_{ink} = 4000 \text{ lb} * 0.375 \text{ lb/lb} * (1-0.2)] * (1 - 0.995) = 6.0 \text{ lbs}$$

Emissions for the fountain solution are calculated using Eq. (3):

$$E_{fountain} = 20 \text{ gal} * 0.8 \text{ lb/gal} * [1 - (0.70 * 0.995)] = 4.86 \text{ lbs}$$

Emissions for the blanket wash are calculated using Eq. (4):

$$E_{wash} = 10 \text{ gal} * 6.7 \text{ lb/gal} * ([1 - (0.4 * 0.995)] = 40.33 \text{ lbs}$$

AER Tool Data Entry For The Above Example

- Click **Emissions Sources (ES)** to see the equipment list (left side of split screen). Click **Open** to access AER device ID ES1.

The screenshot shows the 'Emission Sources (ES) Classification' page in a web browser. The page title is 'Emission Sources (ES) Classification (1.0.0.277)'. The URL is 'http://sqmnd-aer.dyndns.org/Facility/999115/2013'. The page content includes a navigation menu on the left with 'Emission Sources (ES)' selected. The main content area shows 'Facility ID: 999115' and 'Build Reporting Structure'. Below this, there is a section for 'Emission Sources (ES) Classification' with a search form and a table of emission sources. The table has one entry for 'ES1' with a circled 'Open' button in the 'Action' column.

Action	A/N	Permit NO	Permit Device ID	Permit Equipment Description	AER Device ID	ES Name	Source Group	Has Emissions	Equipment	ES Status	Process Reference
Open	111111	D55555			ES1	Other Use of Organics	Y	Printing	Work in progress	Reference	

- Click down arrow for **Operating ES Status** and select **normal operation** from the drop down menu. Next, click on the button for **Determine Emission Source Group Type**.

Facility ID: 999115

Edit Emission Source

Providing correct information and proper selection categories would help to classify emission source.

Permitted

A/N 111111 111111

Permit No D55555

Permit Device ID

Permit Equipment Description

AER Device ID ES1

ES Name

Operating ES Status Normal Operation

Comment

Emission Source Group Other Use of Organics
Determine Emission Source Group Type

Equipment Printing

Design Capacity

Save and return to List of Emission Sources or Save and proceed to Process Reporting or Cancel

- The following screen will appear and click on **click here** number 4 **Other Use of Organics**. Select **Click Here**
- Checkmark **Printing** box by clicking on it
- Click **Save**

Determine Emission Source Group Type

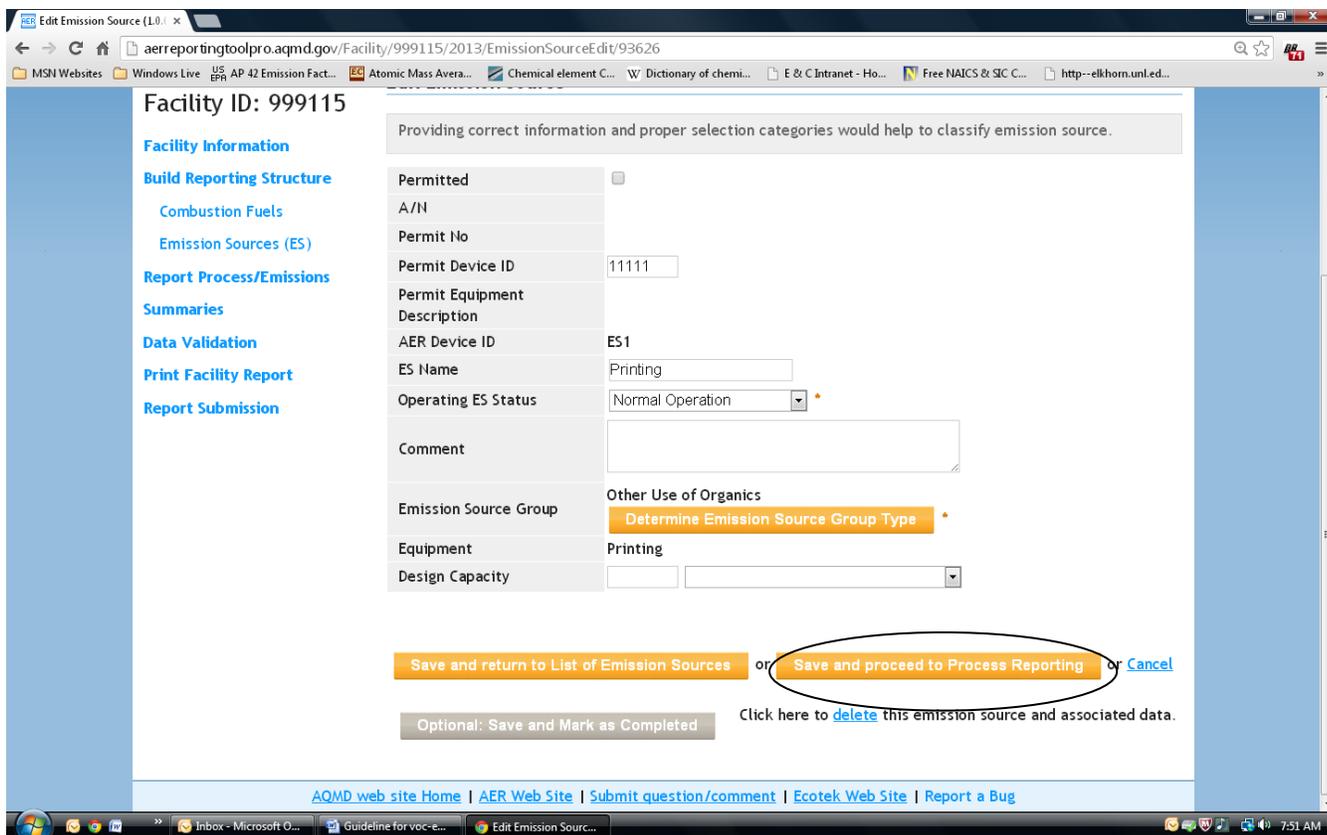
Permitted	A/N	Permit No	Permit Device ID	Permit Equipment Description	AER Device ID	ES Name
Yes	111111	D55555			ES1	

- External Combustion Equipment (e.g., boiler, dryer, oven, furnace, heater, afterburner, flare, kiln or incinerator) [click here](#) to select one of the following Equipment:
- Internal Combustion Equipment (e.g., internal combustion engine (excluding vehicles), turbine or micro turbine) [click here](#) to select one of the following Equipment:
- Spray Coating/Spray Booth (e.g., coatings, solvents, adhesives, etc.) [click here](#) to select one of the following Equipment:
- Other Use of Organics (e.g., coatings, solvents, inks, adhesives, etc.) [click here](#) except in Spray Coating/Spray Booth, [click here](#) to select one of the following Equipment:
 - Degreaser
 - Printing
 - Coating (Flow / Dip / Roll / Hand Application)
 - Other evaporative sources
- Storage Tank (e.g. Underground, Aboveground, Small Tanks, Dispensing Systems) [click here](#) to select one of the following Equipment:
- Fugitive Components (Emission Leaks from Process Components per Rule 1173 and 1176), [click here](#) to select all applicable Equipment:
- Other Processes (does not fit in any of the groups mentioned above), click [click here](#) to mark "Other Process Equipment":

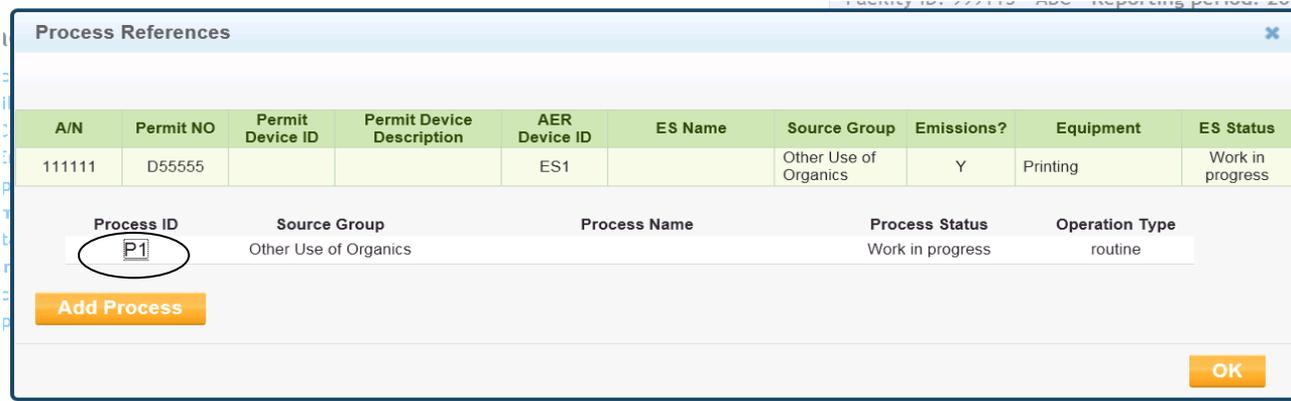
Save Cancel

Display returns to previous image.

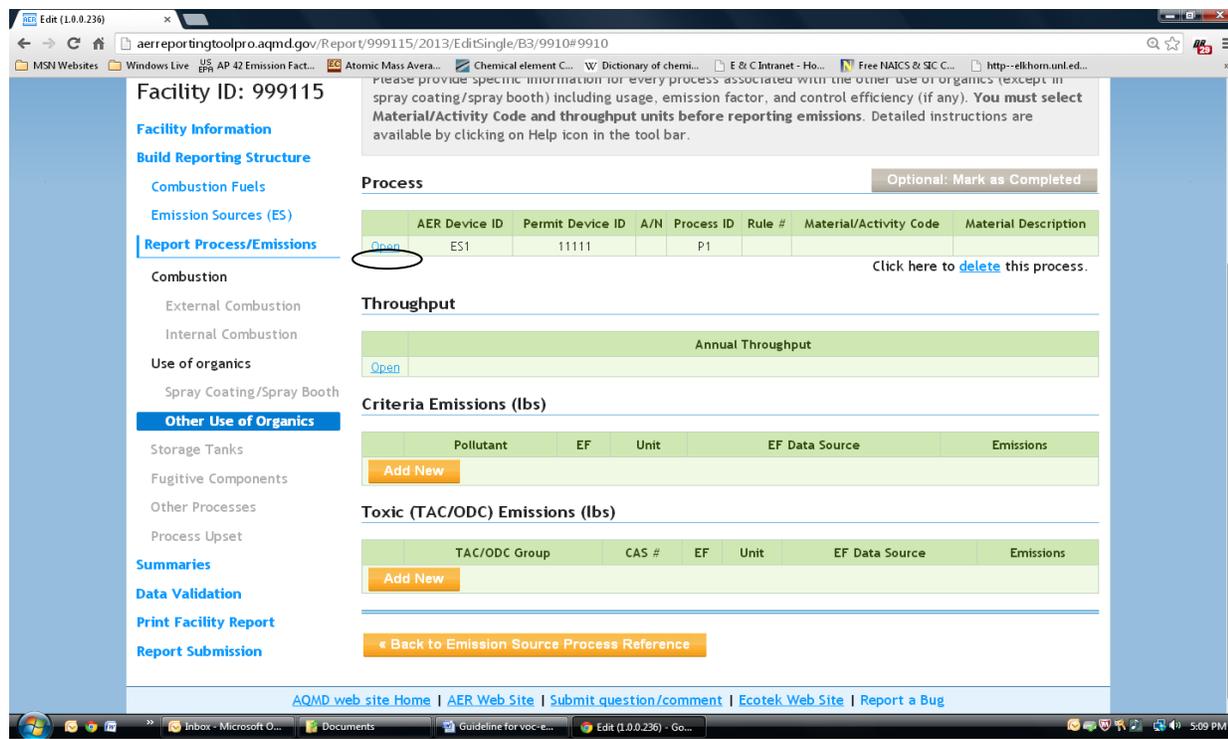
- Click **Save and Proceed to Process Reporting**.



- Click on P1 for the first process.
 Process, in printing operation represent materials used in the printing operation. For each material type (Inks, Varnish, Coatings, Fountain Solution, Metering Roller wash, Roller wash, Blanket wash, etc.), there will be a new process number P1, P2, P3, ...Pn and will be generated by clicking on material type from “Other Use Of Organic” drop-down menu below “Add Process” command, after clicking on “**Back to Emission Source Process Reference**” command for the same permit or emission source from top or bottom left of the data-entry screen for P1. The drop-down menu is generated by clicking on “Add Process” command.



- Under **Process** click **Open**



- The following screen will appear. Fill out and select appropriate data: **Process Name, Major Group, Type of Operation, Application Method, Material Description, and Additional Rule** by clicking the drop-down arrow for each field.
- Click **Save**.

Edit Emission Process - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P1			

AER Device ID	ES1	AER Device Name	
PERMITTED	AN: 111111	Permit Device ID	
Process ID	P1	Process Name	<input type="text"/>
Process Comment	<input type="text"/>		
Equipment	Printing		
Material / Activity *			
Major Group:	Printing		
Type of Operation:	Graphic Arts		
Application Method:	Lithography		
Type of Material:	Web Fed Heatset - Inks		
Material Description	Black Ink *		
Additional Rules	1130	Remove Add Rule	

At this point, add the other two processes that emit VOCs (Fountain Solution and Blanket/Roller

Wash), to complete the individual process associated with this example for Emission Source ES1.

- Click “**Back to Emission Source Process Reference**”.

« Back to Emission Source Process Reference

- Click **Add Process**; select ‘**Other use of Organics**’ from the down arrow pick list. Call the process name **Fountain Solution** and click on **OK**.

Process References ✕

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics		Work in progress	routine

Add Process

Other Use of Organics ▾ Process name: **OK**

OK

- Click on **Open**

AER Home Browse Facilities Access Facility Facility Home 📊 🖨️ 🏠 ?

Facility ID: 999115 · ABC · Reporting period: 2013

Facility ID: 999115

Facility Information

Build Reporting Structure

Combustion Fuels

Emission Sources (ES)

Report Process/Emissions

Combustion

External Combustion

Internal Combustion

Use of organics

Spray Coating/Spray Booth

« Back to Emission Source Process Reference

Other Use of Organics

Please provide specific information for every process associated with the other use of organics (except in spray coating/spray booth) including usage, emission factor, and control efficiency (if any). You must select Material/Activity Code and throughput units before reporting emissions. Detailed instructions are available by clicking on Help icon in the tool bar.

Optional: Mark as Completed

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2			

Click here to [delete](#) this process.

- The following screen pops up. Fill out and select appropriate data: **Process Name, Major Group, Type of Operation, Application Method, Material Description, Additional Rule** by clicking the drop-down arrow for each field.
- Click **Save**. This becomes process **P2**.

Edit Emission Process - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2			

AER Device ID: ES1 AER Device Name:
 PERMITTED AN: 111111 Permit Device ID:
 Process ID: P2 Process Name: Fountain Solution
 Process Comment:
 Equipment: Printing
 Material / Activity *
 Major Group: Printing
 Type of Operation: Graphic Arts
 Application Method: Lithography
 Type of Material: Web Fed Heatset - Fountain Solution
 Material Description: Fountain Solution *
 Additional Rules: 1130 Remove Add Rule

Save Cancel

- Click on the **Back to Emission Source Process Reference** button at the bottom of the subsequent screen.

« Back to Emission Source Process Reference

- The following screen pops up. Select **Add Process**.

Process References

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine

Add Process OK

- The following screen pops up. Select **Other use of Organics** from the down arrow pick list. Call the process name **Blanket/Roller wash** and click on **OK**.

Process References

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine

Add Process

Other Use of Organics | Process name: Blanket/Roller Wash | **OK**

OK

- Click down arrows and select appropriate group, operation, application method, type of material, material description, and Rule 1171. Click **Save**. **This becomes process P3.**

Edit Emission Process - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P3			

AER Device ID: ES1 | AER Device Name: |
 PERMITTED | AN: 111111 | Permit Device ID: |
 Process ID: P3 | Process Name: Blanket/Roller Wash |
 Process Comment: |
 Equipment: Printing |
 Material / Activity * |
 Major Group: Solvents |
 Type of Operation: Solvent Cleaning Operations |
 Application Method: Wipe Cleaning |
 Type of Material: Application Equipment Cleaning - Inks |
 Material Description: Universal Blanket/Roller Wash Solvent * |
 Additional Rules: 1171 | Remove Add Rule |

Save **Cancel**

- Click on the **Back to Emission Source Process Reference** button at the bottom of the subsequent screen.

« Back to Emission Source Process Reference

Process References

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

Add Process

OK

- Click on **P1** to begin data entry of throughput (4,000 lb ink as input). Click **Save**.

Edit Throughput Information - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink

Annual Throughput

Usage (Annual Throughput) * *

Throughput Type *

Usage Comment

Save Cancel

- After entering the throughput, click on **Add New** (Criteria Emissions).

Throughput

Annual Throughput	
Open	4,000.00 lbs

Criteria Emissions (lbs)

Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New						

- Enter the **VOC content** of 0.375 lb/lb, and the **overall control efficiency** of 0.995. The retention factor and the emission factor will be populated for you. Heat set ink oils are 20% retentive (80% evaporative in the heat set dryer). Click **Save**.

Open Criteria Emission Information - Other Use of Organics ✕

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink
Annual Throughput						
4,000.00 lbs						
Pollutant		VOC *				
VOC Volatile Organic Compounds						
Retention Factor (RF)		0.2				
VOC or Litho Oil Content		0.3750			* lbs/lbs	
Emission Factor (EF)		0.3000			* lbs/lbs	
Overall Control Efficiency		0.99500				
Emission Factor Comment		<input type="text"/>				
Emission Factor Data Source		MSDS *				
Emissions		6.00 lbs				

Save
Cancel

Data entry for the ink is complete as per the next screenshot. The ink MSDS shows no standard toxic content.

Process Optional: Mark as Completed

	AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
Open	ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink

Click here to [delete](#) this process.

Throughput

Annual Throughput	
Open	4,000.00 lbs

Criteria Emissions (lbs)

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Open	VOC	0.3000	lbs / lbs	No	MSDS	0.99500	6.00

Add New

Toxic (TAC/ODC) Emissions (lbs)

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New								

- Click **Back to Emission Source Process Reference**, and Select process **P2**.

« Back to Emission Source Process Reference

Process References

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

OK

- Select **Throughput** and enter data (20 gallons fountain solution input). Click **Save**.

Edit Throughput Information - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2	1130	Printing: Graphic Arts: Lithography: Web Fed Heatset - Fountain Solution	Fountain Solution

Annual Throughput

Usage (Annual Throughput) * gal *

Throughput Type *

Usage Comment

Save **Cancel**

- After saving throughput data, click on **Add New** (Criteria Emissions).

Throughput

Annual Throughput	
Open	20.00 gal

Criteria Emissions (lbs)

Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New						

- Enter the **VOC content** of 0.8 lb/gal, and the **overall control efficiency** as the product of the capture efficiency and the destruction efficiency ($0.7 \times 0.995 = 0.6965$). Calculation is performed automatically. Click **Save**.

Open Criteria Emission Information - Other Use of Organics ✕

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Fountain Solution	Fountain Solution
Annual Throughput						
20.00 gal						
Pollutant		VOC - Volatile Organic Compounds				
Emission Factor (EF)		0.8000 * lbs/gal				
Overall Control Efficiency		0.69650				
Emission Factor Comment		Control Efficiency = 0.7 x 0.995				
Emission Factor Data Source		AQMD default *				
Emissions		4.86 lbs				

Click here to [delete](#) this Emission.

Save
Cancel

Data entry for the **Fountain Solution** is complete as per the next screenshot. The ink MSDS shows no standard toxic content.

- Click **Back to Emission Source Process Reference**, and Select process **P3**.

« Back to Emission Source Process Reference

Throughput

	Annual Throughput
Open	20.00 gal

Criteria Emissions (lbs)

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Open	VOC	0.8000	lbs / gal	No	AQMD default	0.69650	4.86

Add New

Toxic (TAC/ODC) Emissions (lbs)

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New								

Process References ✕

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

Add Process
OK

- Repeat steps for Process ID P3 as for P1 and P2. *The throughput is 10 gallons and the emission factor for this example is 6.7 lb/gal. The overall efficiency will be $0.4 \times 0.995 = 0.398$ when entering criteria emission information.* The final screenshot below shows all three processes input into the program, as viewed in **Report Process/Emissions**.

Facility ID: 999115 · ABC · Reporting period: 2013

Facility ID: 999115

[Facility Information](#)

[Build Reporting Structure](#)

[Combustion Fuels](#)

[Emission Sources \(ES\)](#)

[Report Process/Emissions](#)

Combustion

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Use of organics

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Other Use of Organics

Please provide specific information for every process associated with the other use of organics (except in spray coating/spray booth) including usage, emission factor, and control efficiency (if any). You must select Material/Activity Code and throughput units before reporting emissions. Detailed instructions are available by clicking on Help icon in the tool bar.

Other Use of Organics Process List Overview

Add New
Print Preview

Process ID	Status	Material Description	Usage	Units	Em	
					ROG	SPOG
P1	Work in Progress	Black Ink	4,000.00	lbs	6.00	0
P2	Work in Progress	Fountain Solution	20.00	gal	4.86	0
P3	Work in Progress	Universal Blanket/Roller Wash Solvent	10.00	gal	40.33	0