CATEGORY TYPE: **COATING - METAL**

BACT Category: Minor Source BACT

BACT Determination Number: 336	**BACT Determination Date: 1/17/2024**	**ACTIVE**

Equipment Information

Permit Number: N/A -- Generic BACT Determination

Equipment Description: PAINT SPRAY BOOTH

Unit Size/Rating/Capacity: ≤ 6,198 lbs VOC/year and facilities ≤ 40,000 lbs VOC/year

Equipment Location:

BACT Determination Information

District Contact: Jeff Quok Phone No.: (279) 207-1145 email: jquok@airquality.org

ROCs	**Standard:**	See Technology Description
	Technology Description:	1. ≤ 6,198 lb VOC/year limit. 2. HVLP spray or equivalent application equipment. 3. Enclosed spray gun cleaning system. 4. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for General-One Component use 275 g/l and for Etching Filler use 340 g/l for Air-Dried and 275 g/l for Baked.
	Basis:	Achieved in Practice
NOx	**Standard:**	See Technology Description
	Technology Description:	For booth heaters: < 1,200 °F: 30 ppm or 0.036 lb/MMBtu ≥ 1,200 °F: 60 ppm or 0.073 lb/MMBtu
	Basis:	Achieved in Practice
SOx	**Standard:**	No standard
	Technology Description:	
	Basis:	
PM10	**Standard:**	See Technology Description
	Technology Description:	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment
	Basis:	Achieved in Practice
PM2.5	**Standard:**	See Technology Description
	Technology Description:	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment
	Basis:	Achieved in Practice
CO	**Standard:**	For heaters: 400 ppmvd @ 3% O2 or 0.30 lb/MMBtu
	Technology Description:	
	Basis:	Achieved in Practice

Comments (A) Compliance with SMAQMD Rule 451 includes use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.
(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

T-BACT is BACT for Organic HAP/VHAP
T-BACT for Inorganic HAP: Compliance with 40 CFR 63 Subpart HHHHHH for metals – Spray booth filter system with 98% capture efficiency of paint overspray, HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology.

SMAQMD BACT CLEARINGHOUSE

CATEGORY TYPE: **COATING - METAL**

BACT Category: Minor Source BACT

BACT Determination Number: 337	BACT Determination Date: 1/17/2024	ACTIVE

Equipment Information

Permit Number: N/A -- Generic BACT Determination

Equipment Description: PAINT SPRAY BOOTH

Unit Size/Rating/Capacity: > 6,198 lbs VOC/year and facilities > 40,000 lbs VOC/year

Equipment Location:

BACT Determination Information

District Contact: Jeff Quok Phone No.: (279) 207-1145 email: jquok@airquality.org

ROCs	**Standard:**	See Technology Description
	Technology Description:	1.Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard), and VOC control system with overall capture/destruction efficiency ≥ 90%; OR **2. Use of Super Clean Materials (< 5% VOC by weight); OR** **3. Use of low-VOC materials resulting in an equivalent emission reduction as option #1 and option #2.**
	Basis:	Cost Effective
NOx	**Standard:**	See Technology Description
	Technology Description:	For booth heaters: < 1,200 °F: 30 ppm or 0.036 lb/MMBtu ≥ 1,200 °F: 60 ppm or 0.073 lb/MMBtu
	Basis:	Achieved in Practice
SOx	**Standard:**	No standard
	Technology Description:	
	Basis:	
PM10	**Standard:**	See Technology Description
	Technology Description:	1.Enclosed spray booth with properly maintained dry filters or waterwash. 2.HVLP spray or equivalent application equipment
	Basis:	Achieved in Practice
PM2.5	**Standard:**	See Technology Description
	Technology Description:	1.Enclosed spray booth with properly maintained dry filters or waterwash. 2.HVLP spray or equivalent application equipment
	Basis:	Achieved in Practice
CO	**Standard:**	For heaters: 400 ppmvd @ 3% O2 or 0.30 lb/MMBtu
	Technology Description:	
	Basis:	Achieved in Practice

Comments (A) Compliance with SMAQMD Rule 451 includes use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.
(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

T-BACT is BACT for Organic HAP/VHAP
T-BACT for Inorganic HAP is the following: Compliance with 40 CFR 63 Subpart HHHHHH for metals – Spray booth filter system with 98% capture efficiency of paint overspray, HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology.

777 12th Street, Ste. 300

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Sacramento, CA 95814

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

DETERMINATION NOS.:	336 & 337
DATE:	1/26/2024
ENGINEER:	Jeffrey Quok

Category/General Equip Description:	Coating, Stripping, and Solvent Cleaning – Miscellaneous Metal Parts and Products
Equipment Specific Description:	Paint Spray Booth
Equipment Size/Rating:	≤ 6,198 lbs VOC/year and facilities ≤ 40,000 lbs VOC/year (BACT #336) > 6,198 lbs VOC/year and facilities > 40,000 lbs VOC/year (BACT #337)
Previous BACT Det. No.:	#234 & #235

This Best Available Control Technology (BACT) determination is for coating, stripping, and solvent cleaning - miscellaneous metal parts and products. Miscellaneous metal parts are defined as any metal parts except as specified in SMAQMD Rule 451, Sections 111, 112, and 116. These exemptions are for operations subject to other District Rules, specific operations and coatings, and automobile and light-duty truck assembly coating operations, respectively.

BACT/T-BACT ANALYSIS

A. ACHIEVED IN PRACTICE (Rule 202, §205.1a):

The following control technologies are currently employed as BACT for coating, stripping, and solvent cleaning - miscellaneous metal parts and products by the following agencies and air pollution control districts:

US EPA

BACT
Source: EPA RACT/BACT/LAER Clearinghouse

RBLC ID: OH-0371 (9/26/2017)

This BACT determination was found to be the most stringent Achieved in Practice BACT determination published in the EPA clearinghouse. See Attachment A for more information.

Frame Flow Coater – 60 TPY	
VOC	Extreme performance coating: 3.5 lb VOC/gal, excluding water, and exempt solvents, as applied
NOx	N/A – No BACT determinations
SOx	N/A – No BACT determinations
PM10	N/A – No BACT determinations
PM2.5	N/A – No BACT determinations
CO	N/A – No BACT determinations

T-BACT
Source: EPA RACT/BACT/LAER Clearinghouse
RBLC ID: NV-0049 (8/20/2009)

Paint Spray Booth	
Organic HAP	Use of HVLP spray guns, keep VOC-containing materials in closed containers, limit of organic HAP content to 47% by weight of the VOC content.(A)

(A) This paint spray booth's usage of paints, lacquers, thinners, and solvents is limited to 50 gallons per month and 500 gallons per year.

RULE REQUIREMENTS:

40 CFR 63 Subpart MMMM – National Emission Standards for Hazardous Air Pollutants for Surface Coating of Miscellaneous Metal Parts and Products
This regulation applies for facilities that are engaged, either in part or in whole, in the manufacture of miscellaneous metal parts and product, that use 250 gallons per year or more of coatings that contain HAPs, and that are located at a plant site that is a major source as defined in 40 CFR subpart A, §63.2. These BACT Determinations are only for minor sources, therefore this subpart does not apply.

Subpart MMMM limits hazardous air pollutants (HAP) for miscellaneous metal parts and products surface coating facilities. The limits can be seen in the table below.

Organic HAP Emission Limits for Coating Types §63.3890

Subcategory	Organic HAP Emission Limits kg HAP/liter of coating solids (lb HAP/gal of coating solids)	
	New/Reconstructed Sources(A)	Existing Sources(B)
General Use Coating	0.23 (1.9)	0.31 (2.6)
High Performance Coating	3.3 (27.5)	3.3 (27.5)
Magnet Wire Coating	0.05 (0.44)	0.12 (1.0)
Rubber-to-Metal Coating	0.81 (6.8)	4.5 (37.7)
Extreme Performance Fluoropolymer Coating	1.5 (12.4)	1.5 (12.4)

(A) A source is a new/reconstructed source if construction is commenced after August 12, 2002.
(B) An existing source means any affected source that is not a new or reconstructed source.

Work Practice Standards

(a) For any coating operation(s) on which you use the compliant material option or the emission rate without add-on controls option, no work practice standards are required to be met.

(b) If the emission rate with add-on controls option is used, the source must develop and implement a work practice plan to minimize organic HAP emissions from the storage, mixing, and conveying of coatings, thinners and/or other additives, and cleaning materials used in, and waste materials generated by the controlled coating operation(s) for using this option; or the source must meet an alternative standard as provided in paragraph (c) of this section. The plan must specify practices and procedures to ensure that, at a minimum, the elements specified in paragraphs (b)(1) through (5) of this section are implemented.
   (1) All organic-HAP-containing coatings, thinners and/or other additives, cleaning materials, and waste materials must be stored in closed containers.
   (2) Spills of organic-HAP-containing coatings, thinners and/or other additives, cleaning materials, and waste materials must be minimized.
   (3) Organic-HAP-containing coatings, thinners and/or other additives, cleaning materials, and waste materials must be conveyed from one location to another in closed containers or pipes.
   (4) Mixing vessels which contain organic-HAP-containing coatings and other materials must be closed except when adding to, removing, or mixing the contents.
   (5) Emissions of organic HAP must be minimized during cleaning of storage, mixing, and conveying equipment.
(c) As provided in §63.6(g), the U.S. Environmental Protection Agency, may choose to grant the source permission to use an alternative to the work practice standards in this section.

40 CFR 63 Subpart HHHHHH – National Emission Standards for Hazardous Air Pollutants for Paint Stripping and Miscellaneous Surface Coating Operations at Area Sources

This subpart applies to spray application of coatings containing compounds of chromium (Cr), lead (Pb), manganese (Mn), nickel (Ni), or cadmium (Cd), collectively referred to as the target

HAP to any part or product made of plastic. This subpart also applies to operations using MeCl for the removal of dried paint.

General Requirements

For paint stripping operations using MeCl:

A. Implement management practice to minimize the evaporative emissions of MeCl. The management practices must address practices in paragraphs 1 through 5, as applicable.
   1. Evaluate each application to ensure there is a need for paint stripping.
   2. Evaluate each application where a paint stripper containing MeCl is used to ensure that there is no alternative paint stripping technology that can be used.
   3. Reduce exposure of all paint strippers containing MeCl to the air.
   4. Optimize application conditions when using paint strippers containing MeCl to reduce MeCl evaporation.
   5. Practice proper storage and disposal of paint strippers containing MeCl.

For coatings that may potentially contain the target HAP compounds of chromium, lead, manganese, nickel, or cadmium:

A. All spray-applied coatings must be performed in a spray booth, preparation station, or mobile enclosures that are fully enclosed with a full roof with four walls or complete side curtains. The enclosure must be ventilated at a negative pressure and equipped with a filter system that can achieve at least 98% capture efficiency.
B. Coatings must be applied with HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology for which written approval has been obtained from the U.S. EPA.
C. Spray gun cleaning must be conducted such that an atomized mist or spray of gun cleaning solvent and paint residue is not created outside of a container that collects used cleaning solvent.
D. All new and existing personnel who spray-apply surface coatings must be trained in the proper application of surface coatings.
E. For new affected sources, submit an initial notification to EPA no later than 180 days after initial startup or July 7, 2008, whichever is later. For an existing affected source, submit the initial notification no later than January 11, 2010.

California Air Resource Board (CARB)

BACT

Source: CARB BACT Clearinghouse
CARB BACT Guidelines Search

The CARB BACT Clearinghouse and Guidelines Search did not contain any BACT determinations that were applicable to this determination.

RULE REQUIREMENTS: None

Sacramento Metropolitan AQMD

BACT

Source: SMAQMD BACT #234 & #235 – Coatings – Misc. Metal Parts and Products (12/08/20)

BACT #234 for Paint Spray Booths for Miscellaneous Metal Parts and Products Coatings < 5,475 lbs VOC/year	
Pollutant	**Standard**
VOC	1. < 5,475 lb VOC/year limit 2. HVLP spray or equivalent application equipment 3. Enclosed spray gun cleaning system 4. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard).
NOx	For heaters: low NOx burner, 30 ppmvd @ 3% O_2 or 0.036 lb/MMBtu
SOx	No standard
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment.
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment.
CO	For heaters: 400 ppmvd @ 3% O_2 or 0.30 lb/MMBtu

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. If the operation qualifies for exemption of VOC content limits the BACT VOC content limits are exempt as well.

T-BACT #234 for Paint Spray Booths for Miscellaneous Metal Parts and Products Coatings < 5,475 lbs VOC/year	
Pollutant	**Standard**
Organic HAP (T-BACT)	1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content to 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard).

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

BACT #235 for Paint Spray Booths for Miscellaneous Metal Parts and Products Coatings ≥ 5,475 lb VOC/year	
Pollutant	**Standard**
VOC	1. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard), and VOC control system with overall capture/destruction efficiency ≥ 90%; OR 2. Use of Super Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction as option #1 and option #2.
NOx	For heaters: low NOx burner, 30 ppmvd @ 3% O_2 or 0.036 lb/MMBtu
SOx	No standard
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment
CO	For heaters: 400 ppmvd @ 3% O_2 or 0.30 lb/MMBtu

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

T-BACT #235 for Paint Spray Booths for Miscellaneous Metal Parts and Products Coatings ≥ 5,475 lb VOC/year	
Pollutant	**Standard**
Organic HAP (T-BACT)	1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content of 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard). With VOC control system with overall capture/destruction efficiency ≥ 90%; OR 6. Use of Super Clean Materials (< 5% VOC by weight); OR 7. Use of low-VOC materials resulting in an equivalent emission reduction as option #5 and option #6

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

RULE REQUIREMENTS:

Rule 451 – Surface Coating of Misc. Metal Parts and Products (Last amended 10/20/2010)

One of the following methods shall be used when applying miscellaneous metal part or product coatings to any miscellaneous metal parts and products:

A. Roll Coater
B. Dip coat
C. Electrostatic spray
D. Flow Coat
E. High-volume low-pressure (HVLP) spray
F. Low-volume low-pressure (LVLP) spray
G. Hand application method, such as brush or roller
H. Any other method which has been approved in writing by the Air Pollution Control Officer and the U.S. EPA

No person shall apply any coating, to a **miscellaneous metal parts and product**, which has a VOC content exceeding the applicable limits below:

Coating Category (SMAQMD Rule 451 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	Air Dried	Baked
Aluminum Coating for Window Frames and Door Frames	420 (3.5)	275 (2.3)
Camouflage	420 (3.5)	360 (3.0)
Electrical Insulating	340 (2.8)	275 (2.3)
Etching Filler	420 (3.5)	420 (3.5)
Extreme High Gloss	420 (3.5)	360 (3.0)
Extreme Performance	420 (3.5)	360 (3.0)

Coating Category (SMAQMD Rule 451 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	Air Dried	Baked
Heat Resistant	420 (3.5)	360 (3.0)
Metallic/Iridescent	420 (3.5)	420 (3.5)
Prefabricated Architectural Component	420 (3.5)	275 (2.3)
Pretreatment Wash Primer	420 (3.5)	420 (3.5)
Silicone Release Coating	420 (3.5)	420 (3.5)
Solar Absorbent	420 (3.5)	360 (3.0)
All Other Coatings	340 (2.8)	275 (2.3)

VOC content of coatings used for **metal furniture** shall not exceed the following limits:

Coating Category (SMAQMD Rule 451 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	Air Dried	Baked
General, Multi-Component	340 (2.8)	275 (2.3)
Etching Filler	420 (3.5)	420 (3.5)
Extreme High Gloss	340 (2.8)	360 (3.0)
Extreme Performance	420 (3.5)	360 (3.0)
Heat Resistant	420 (3.5)	360 (3.0)
Metallic/Iridescent	420 (3.5)	420 (3.5)
Pretreatment Wash Primer	420 (3.5)	420 (3.5)
Solar Absorbent	420 (3.5)	360 (3.0)
All Other Coatings	275 (2.3)	275 (2.3)

VOC content for coating removers (strippers):

- A person shall not use a stripper on miscellaneous metal parts and products which contain more than 200 grams of VOC per liter of material (1.7 pounds per gallon).

VOC content surface preparation and cleanup materials:

- A person shall not perform cleanup of application equipment (including spray gun nozzles) with a material containing VOC in excess of 25 grams per liter (0.21 pounds per gallon).
- A person shall not perform product cleaning or surface preparation with a material containing VOC in excess of 25 grams per liter (0.21 pounds per gallon).

Rule 419 – NOx from Miscellaneous Combustion Units (10/25/18)

This Rule applies to any miscellaneous combustion unit or cooking unit with a total rated heat input capacity of 2 MMBtu/hr or greater that is located at a major stationary source of NOx and to any miscellaneous combustion unit or cooking unit with a total rated heat input capacity of 5 MMBtu/hr or greater that is not located at a major stationary source of NOx.

The requirements of this rule do not apply to combustion equipment where its primary function is to operate as an air pollution control device including, but not limited to, afterburners, catalytic oxidizers, flares, thermal oxidizers, or vapor incinerators.

TABLE 1: Miscellaneous Combustion Units Emission Limits Expressed As PPMV, corrected to 3% O_2			
Equipment Category	**NOx Limit ppmv, corrected to 3% O_2 (lb/MMBtu)**		**CO Limit ppmv, corrected to 3% O_2 (lb/MMBtu)**
Gaseous Fuel-Fired Equipment	**Process Temperature**		**All Temperatures**
	< 1200°F	≥ 1200 °F	
Other Miscellaneous Combustion Unit	30 (0.036)	60 (0.073)	400 (0.30)

South Coast AQMD

BACT

Source: SCAQMD BACT Guidelines (Part D) for Non-Major Polluting Facilities, page 117 & 118 (9/2/2022)

Spray Booth	
VOC	For booths with < 1,170 lbs/month VOC Emissions (14,040 lb/year) 1. Compliance with applicable AQMD Regulation XI Rules For booths with ≥ 1,170 lbs/month VOC Emissions (14,040 lb/year) 1. Compliance with applicable AQMD Regulation XI Rules, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR 2. Use of Super Compliant Materials (< 50 grams of VOC per liter of material); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction
VOC	For fully enclosed down-draft type booths, with < 667 lbs/month (8,004 lb/year) VOC Emissions 1. Compliance with applicable AQMD Regulation XI Rules For fully enclosed down-draft type booths, with ≥ 22 lbs/day (8,030 lb/year) VOC Emissions 1. Compliance with applicable AQMD Regulation XI Rules, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR 2. Use of Super Compliant Materials (< 50 grams of VOC per liter of material); OR Use of low-VOC materials resulting in an equivalent emission reduction
NOx	For booths with make-up air unit or a heater Compliance with Rule 1147 (2-5-2021)
SOx	No standard
PM10	Dry filters or water wash
PM2.5	No Standard
CO	No standard

For BACT comparison purposes, daily and monthly thresholds have been converted to annual equivalents based on 365 days/year and 12 months/year.

T-BACT

There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Reg XI, Rule 1107 – Coating of Metal Parts and Products (Amended 1/6/23)

A person or facility shall not apply coatings to metal parts and products subject to the provisions of this rule unless the coating is applied with properly operating equipment, according to the equipment

manufacturer's operating procedures, and by the use of one of the following methods:

A. Electrostatic application
B. Flow coat
C. Dip coat
D. Roll coat
E. High-volume, low-pressure (HVLP) spray
F. Hand Application Methods
G. Other coating application methods as are demonstrated to the Executive Officer to be capable of achieving a transfer efficiency equivalent or better to HVLP spray, and for which written approval of the Executive officer has been obtained

An operator shall not apply **any coating to metal parts and products** that exceeds the applicable limit specified below:

Coating Category (SCAQMD Rule 1107 Definition)	**Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)**	
	Air Dried	**Baked**
General One-Component	275 (2.3)	275 (2.3)
General, Multi-Component	340 (2.8)	275 (2.3)
Military Specification	340 (2.8)	275 (2.3)
Etching Filler	420 (3.5)	420 (3.5)
Solar Absorbent	420 (3.5)	360 (3.0)
Heat Resistant	420 (3.5)	360 (3.0)
Extreme High Gloss	340 (2.8)	360 (3.0)
Metallic	420 (3.5)	360 (3.0)
Extreme Performance	420 (3.5)	360 (3.0)
Prefabricated Architectural One-Component	275 (2.3)	275 (2.3)
Prefabricated Architectural Multi-Component	340 (2.8)	275 (2.3)

Coating Category (SCAQMD Rule 1107 Definition)	**Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)**	
	Air Dried	**Baked**
Touch Up	420 (3.5)	360 (3.0)
Repair	420 (3.5)	360 (3.0)
Silicone Release	420 (3.5)	420 (3.5)
High-Performance Architectural	420 (3.5)	420 (3.5)
Camouflage	420 (3.5)	360 (3.)

Coating Category (SCAQMD Rule 1107 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	Air Dried	Baked
Vacuum-Metalizing	420 (3.5)	420 (3.5)
Mold-Seal	420 (3.5)	420 (3.5)
High-Temperature	420 (3.5)	420 (3.5)
Electric-Insulating Varnish	420 (3.5)	420 (3.5)
Pan Backing	420 (3.5)	420 (3.5)
Pretreatment Coatings	420 (3.5)	420 (3.5)

VOC Content for coating removers (strippers):
A person shall not use a stripper on miscellaneous metal parts and products which contain more than 200 grams of VOC per liter of material.

High Viscosity Coating Application Equipment Exemption Discussion
SCAQMD Rule 1107 contains an application equipment exemption per section (f)(8) for metal coatings with a viscosity of 650 centipoise or greater, as applied.

SCAQMD provided the following explanation for a similar exemption for Rule 1106 Marine and Pleasure Craft Coatings on page 2-24 of the Staff Report for Rule 1106:

> "Staff proposes to include an exemption in the proposed amendment for certain coatings that are too thick to be sprayed by conventional spray equipment. The proposal will exempt coatings that have a viscosity greater than 650 centipoise, which have poor flow characteristics, from the proposed transfer efficiency requirements in paragraph (d)(8), Application Equipment Transfer Efficiency, including HVLP. The spraying equipment required to spray such thick fluids includes spraying equipment such as plural type application equipment or spraying equipment that must use very high pressure (greater than 1,000 psi) and heated elements to apply coatings. Without the proposed exemption, shops forced to use HVLP equipment would otherwise have to thin high solids coatings with VOC solvents to allow them to be sprayed, thus eliminating the benefit of the low-VOC high solids coatings. Staff proposes the following rule language to exempt coatings that have a viscosity of 650 centipoise or greater from the requirements in paragraph (d)(8):
>
> The provisions of paragraph (d)(8) shall not apply to Marine or Pleasure Craft coatings with a viscosity of 650 centipoise or greater, as applied."

This explanation is valid for SCAQMD's Rule 1107 Coating of Metal Parts as both coating types can have high viscosity coatings. SMAQMD agrees that due to HVLP not being technologically feasible with high viscosity coatings, an application equipment exemption is needed. Therefore, this BACT Determination will include a 650 centipoise or greater application equipment exemption.

Reg XI, Rule 1132 – Further Control of VOC Emissions from High-Emitting Spray Booth Facilities (Last amended 5/5/2006)

This rule applies to any spray both facilities, except petroleum industry facilities, that uses VOC-containing materials that amount to more than 40,000 pounds (20 tons) per year of VOC emissions in any emission inventory year beginning in 1999.

Standards

A person shall not operate any spray booth facility subject to this rule, unless the VOC emissions from any equipment, activity or operation that applies, or is required by any District rule, regulation or permit to apply, VOC-containing materials in a spray booth are reduced through the use of the following:

A. An emission control system that has an overall efficiency of at least 65 percent by weight; or
B. VOC-containing materials that have a VOC content at least 65 percent lower than any applicable rule limit in effect as of January 19, 2001; or
C. A combination of methods specified in paragraphs (c)(1) and (c)(2), which when individually applied do not meet the specified reduction

RULE REQUIREMENTS:

Reg XI, Rule 1147 – NOx Reductions from Miscellaneous Sources
(Last amended 5/6/2022)

This rule applies to ovens, dryers, dehydrators, heaters, kilns, calciners, furnaces, crematories, incinerators, heated pots, cookers, roasters, fryers, closed and open heated tanks and evaporators, distillation units, afterburners, degassing units, vapor incinerators, catalytic or thermal oxidizers, soil and water remediation units and other combustion equipment with nitrogen oxide emissions that require a District permit and are not specifically required to comply with a nitrogen oxide emission limit by other District Regulation XI rules.

However, Reg II, Rule 219 exempts combustion equipment firing natural gas, for which the maximum heat input is 2,000,000 Btu/hr or less. Therefore, in practice, the below standards only apply to booth heaters with a heat input greater than 2,000,000 Btu/hr.

Equipment Category	**NOx Emission Limit PPM @ 3% O_2, dry or pound/MMBtu heat input for ≤ 2.0 MMBtu/hr**	
	Process Temperature	
	< 1,200 °F	**≥ 1,200 °F**
Other Unit or Process Temperature	30 ppm or 0.036 lb/MMBtu	60 ppm or 0.073 lb/MMBtu

CO limit for all units is 1,000 ppmv at 3% O_2.

San Joaquin Valley APCD

BACT
Source: SJVUAPCD BACT Guideline

SJVAPCD does not have an active BACT guideline for this source category. Guidelines 4.3.1 and 4.3.2 for Metal Parts and Products Coating – Air Dried and Heat Dried have been rescinded (5/11/22).

RULE REQUIREMENTS:
Rule 4603 – Surface Coating of Metal Parts and Products, Plastic Parts and Products, and Pleasure Crafts (Amended 9/17/2009)
An operator shall not apply coatings to metal parts and products subject to the provisions of this rule unless the coating is applied with properly operating equipment, according to proper operating procedures, and by the use of one of the following methods:

A. Electrostatic application
B. Electrodeposition
C. High-Volume, Low-Pressure (HVLP) spray
   i. HVLP spray equipment shall be operated in accordance with manufacturer's recommendations.
   ii. For HVLP spray guns manufactured prior to January 1, 1996, the end user shall demonstrate that the gun meets HVLP spray equipment standards. Satisfactory proof will be either in the form of manufacturer's published technical material or by a demonstration using a certified air pressure tip gauge, measuring the air atomizing pressure dynamically at the center of the air cap and at the air horns.
D. Flow coating
E. Roll coating
F. Dip coating
G. Brush coating
H. Continuous coating; or
I. Other coating application methods which are demonstrated to the APCO to be capable of achieving at least 65% transfer efficiency as determined in accordance with Section 6.3.8. Prior written approval from the APCO shall be obtained for each alternative method used.

General Coating Limits
Except as otherwise provided by this rule, no operator shall apply to any metal part or product any coating with a VOC content in excess of the following limits, expressed as grams of VOC per liter (or pounds per gallon) of coating, less water and exempt compounds, as applied.

- Air-Dried Coating: 340 grams/liter (2.8 pounds/gallon).
- Baked Coating: 275 grams/liter (2.3 pounds/gallon).

VOC content limit for dip coating of steel joists (SIC 3441), air-dried.

- 340 grams of VOC/liter (2.8 pounds of VOC/gallon) for coatings with a viscosity, as applied, of more than 45.6 centistokes at 78°F or an average dry-film thickness of greater than 2.0 mils;
- 400 grams of VOC/liter (3.32 pounds of VOC/gallon) for coatings with a viscosity, as applied, of less than or equal to 45.6 centistokes at 78°F and an average dry-film thickness of less than or equal to 2.0 mils.

Specialty Coating Limits
An operator shall not apply to any metal part or product any specialty coating with a VOC content in excess of the limits in the table below, except for large appliance parts or products, and metal furniture.

Coating Category (SJVAPCD Rule 4603 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	AIR DRIED	BAKED
Camouflage	420 (3.5)	360 (3.0)
Extreme Performance	420 (3.5)	360 (3.0)
Heat Resistant	420 (3.5)	360 (3.0)
Extreme High Gloss	420 (3.5)	360 (3.0)
High Performance Architectural	420 (3.5)	420 (3.5)
High Temperature	420 (3.5)	420 (3.5)
Metallic Coating	420 (3.5)	360 (3.0)
Pretreatment Wash Primer	420 (3.5)	420 (3.5)
Touch Up and Repair coating	420 (3.5)	360 (3.0)
Silicone Release	420 (3.5)	420 (3.5)
Solar Absorbant	420 (3.5)	360 (3.0)
Solid Fill Lubricant	880 (7.3)	880 (7.3)

Large Appliance Parts or Products and Metal Furniture Coating Limits
An operator shall not apply any coating to large appliance parts or products, and metal furniture, which has a VOC content, as applied, that exceeds the applicable limit specified below:

Coating Category (SJVAPCD Rule 4603 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	AIR DRIED	BAKED
General, One Component	275 (2.3)	275 (2.3)
General, Multi- Component	340 (2.8)	275 (2.3)
Extreme High Gloss	340 (2.8)	360 (3.0)
Extreme Performance	420 (3.5)	360 (3.0)
Heat Resistant	420 (3.5)	360 (3.0)
Metallic Coating	420 (3.5)	420 (3.5)
Pretreatment Coating	420 (3.5)	420 (3.5)
Solar Absorbent	420 (3.5)	360 (3.0)

Solvent Cleaning
VOC content limits for organic solvents used in cleaning operations, limits are expressed as grams of VOC/liter (or pounds of VOC/gallon) of material:

Type of Solvent Cleaning Operation	VOC Content Limit
Product cleaning during manufacturing process or surface preparation for coating application	25 (0.21)
Repair and maintenance cleaning	25 (0.21)
Cleaning of coating application equipment	25 (0.21)

San Diego County APCD

BACT
Source: NSR Requirements for BACT, page 3-20. (June 2011)

Metal Parts & Products coating (<10 gal/day)	
VOC	Compliance with Rule 67.3, Metal Parts & Products Coating Operations
NOx	No standard
SOx	No standard
PM10	Spray booth equipped with overspray filters
PM2.5	Spray booth equipped with overspray filters
CO	No standard

RULE REQUIREMENTS:
Regulation 4, Rule 67.3 – Metal Parts and Products Coating Operations (Amended 4/9/2003)

No coatings shall be applied unless one of the following coating application methods is used:
- Electrostatic spray application
- Flow coat application
- Dip coat application
- High-volume low-pressure (HVLP) spray application
- Roll coat
- Hand application methods
- Other coating application methods that are demonstrated to have a transfer efficiency a least equal to one of the above application methods, and which are used in such a manner that the parameters under which they were tested are permanent features of the method. Such coating application methods shall be features in writing prior to use by the Air Pollution Control Officer.

General Coating Limits
Except as otherwise provided by this rule, no operator shall apply to any metal part or product any coating with a VOC content in excess of the following limits, expressed as grams of VOC per liter (or pounds per gallon) of coating, less water and exempt compounds, as applied.

- Air-Dried Coating: 340 grams/liter (2.8 pounds/gallon).
- Baked Coating: 275 grams/liter (2.3 pounds/gallon).

A person shall not apply any **specialty coating to metal parts and products** with a VOC content in excess of the following limits expressed as either grams of VOC per liter of coating or pounds of VOC per gallon of coating, as applied, less water and exempt compounds:

Coating Category (SDCAPCD Rule 67.3 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	Air Dried	Baked
Chemical Agent Resistant	420	420
Heat Resistant	420	360
High Gloss	420	360
High Performance Architectural	420	420
Metallic Topcoat	420	360
Pretreatment Wash Primer	420	420
Solar Absorbent	420	360
All Other Coatings	340	275

Surface Preparation and Cleanup Solvents
A person shall not use VOC containing materials for surface preparation or cleanup unless:
- The material contains 200 grams or less of VOC per liter of material; or
- The material has an initial boiling point of 190°C (374°F) or greater; or
- The material has a total VOC vapor pressure of 2 mm Hg or less, at 20°C (68°F)

Cleaning of Application Equipment
A person shall not use VOC containing materials for the cleaning of application equipment used in operations subject to this rule unless:
- The material contains 200 grams or less of VOC per liter of material; or
- The material has an initial boiling point of 190°C (374°F) or greater; or
- The material has a total VOC vapor pressure of 2 mm Hg or less, at 20°C (68°F); or
- The cleaning material is flushed or rinsed through the application equipment in a contained manner that will minimize evaporation into the atmosphere; or
- The application equipment or equipment parts are cleaned in a container which is open only when being accessed for adding, cleaning, or removing application equipment or when cleaning material is being added, provided the cleaned equipment or equipment parts are drained to the container until dripping ceases; or
- A system is used that totally encloses the component parts being cleaned during the washing, rinsing, and draining processes; or
- Other application equipment cleaning methods that are demonstrated to be as effective as any of the equipment described above in minimizing the emissions of VOC to the atmosphere, provided that the device has been tested and approved prior to use by the Air Pollution Control Officer.

A person shall not use VOC containing materials for the cleaning of coating application equipment used in operations subject to this rule unless:

- The cleaning material contains 25 grams or less of VOC per liter of material; or
- The cleaning material is flushed or rinsed through the application equipment in a contained manner that will minimize evaporation into the atmosphere; or
- The application equipment or equipment parts are cleaned in a container which is open only when being accessed for adding, cleaning, or removing application equipment or when cleaning material is being added, provided the cleaned equipment or equipment parts are drained to the container until dripping ceases; or
- A system is used that totally encloses the component parts being cleaned during the washing, rinsing, and draining processes.

Bay Area AQMD

BACT

Source: BAAQMD BACT Guideline
Document # 161.5.1 for < 50lb/day (12/16/03)
Document # 161.5.2 for ≥ 50 lb/day (12/13/91)

Spray Booths – Miscellaneous Metal Parts and Products	
VOC	For < 50 lb VOC/day emissions (< 18,250 lb/year equivalence) 1. Coatings with VOC content and transfer efficiency complying with Reg. 8, Rule 19, and emissions controlled to overall capture/destruction efficiency ≥ 90% by weight (Technologically Feasible); or 2. Complying with Reg. 8, Rule 19 (Achieved in Practice) For ≥ 50 lb VOC/day emissions (≥ 18,250 lb/year equivalence) 1. Coatings with VOC content less than and transfer efficiency greater than that required by Reg. 8, Rule 19, and emissions controlled to overall capture/destruction efficiency ≥ 90% by weight (Technologically Feasible); or 2. Complying with VOC content and transfer efficiency complying with Reg. 8, Rule 19, and emissions controlled to overall capture/destruction efficiency ≥ 90% (Achieved in Practice)
NOx	No standard
SOx	No standard
PM10	Dry filters or waterwash, properly maintained
PM2.5	No standard
CO	No standard

T-BACT

There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

BAAQMD Regulation 8, Rule 19 – Surface Preparation and Coating of Miscellaneous Metal Parts and Products (Amended 10/16/2002)

Any person who utilizes spray application equipment to apply coatings to miscellaneous metal parts or products shall use one or more of the following application methods, unless emissions to the

atmosphere are controlled by an approved emission control system with an overall abatement efficiency of at least 85%:

A. High Volume Low Pressure (HVLP) Spray, operated in accordance with the manufacturer's recommendations; or
B. Electrostatic spray, operated in accordance with the manufacturer's recommendations; or
C. Detailing Gun; or
D. Any other coating spray application that achieves an equivalent transfer efficiency compared to the spray application methods listed above. Prior written approval from the APCO shall be obtained for each alternative method used.

No person shall apply to any **miscellaneous metal part or product**, any specialty coating with a VOC content in excess of the limits set forth below; expressed as grams VOC per liter (pounds VOC per gallon) of coating or grams VOC per liter (lbs VOC per gal) of coating applied, excluding water, unless emissions to the atmosphere are controlled to an equivalent level by air pollution abatement equipment with an abatement device efficiency of at least 85% that meets the requirements of Regulation 2, Rule 1.

Coating Category (BAAQMD Rule 19 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/gal)	
	Air Dried	Baked
Camouflage	420 (3.5)	360 (3.0)
High Gloss	420 (3.5)	360 (3.0)
Heat Resistant	420 (3.5)	360 (3.0)
High Performance Architectural	420 (3.5)	420 (3.5)
Metallic Topcoat	420 (3.5)	360 (3.0)
Pretreatment Wash Primer	420 (3.5)	420 (3.5)
Silicone Release	420 (3.5)	420 (3.5)
Solar Absorbent	420 (3.5)	360 (3.0)
Extreme Performance	420 (3.5)	420 (3.5)
High Temperature	420 (3.5)	420 (3.5)
All Other Coatings	340 (2.8)	275 (2.3)

Solvent Evaporative Loss Minimization:

Unless emissions to the atmosphere are controlled by an approved emission control system with an overall abatement efficiency of at least 85%, any person using organic solvent for surface preparation and cleanup or any person mixing, using or disposing of coating containing organic solvent:

A. Shall use closed containers for the storage or disposal of cloth or paper used for solvent surface preparation and clean up.
B. The person shall not use organic solvent for the cleanup of spray equipment, including paint lines with VOC content in excess of 50 g/l (0.42 lb/gal) unless either
    i. The solvent is pressurized through the spray equipment with atomizing air off or dispensed from a small non-atomizing container, and collected and stored in a closed container until recycled or properly disposed of offsite, or

ii. A spray gun washer subject to and in compliance with the requirements of Regulation 8, Rule 16 is used.

C. Shall close containers of coating, catalyst, or solvent when not in use.

Surface Preparation Standards:
No person shall use a solvent with a VOC content that exceeds 50 g/l (0.42 lbs/gal), as applied, for surface preparation in any operation subject to this Rule unless emissions to the atmosphere are controlled to an equivalent level by an approved emission control system with an overall abatement efficient of at least 85%.

Summary of Achieved in Practice Control Technologies

The following control technologies have been identified and are ranked based on stringency:

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
VOC	<u>For booths without add-on controls</u> 1. 5,475 lb VOC/year limit, HVLP spray or equivalent application equipment, enclosed spray gun cleaning system, compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard) – [SMAQMD] 2. Compliance with SCAQMD Regulation XI, Rule 1107 – [SCAQMD] 3. Compliance with SDCAPCD Rule 67.3 – [SDCAPCD] 4. Compliance with BAAQMD Regulation 8, Rule 19 – [BAAQMD] 5. Extreme performance coating: 3.5 lb VOC/gal or less (excluding water and exempt solvents, as applied). [EPA: OH-0371] <u>For booths with add-on controls</u> 1a. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard), and VOC control system with overall capture/destruction efficiency ≥ 90%; OR [SMAQMD] 1b. Use of Super Clean Materials (< 5% VOC by weight); OR [SMAQMD] 1c. Use of low-VOC materials resulting in an equivalent emission reduction [SMAQMD] 2. Complying with VOC content and transfer efficiency required by BAAQMD Reg. 8, Rule 19, and emissions controlled to overall capture/destruction efficiency ≥ 90% [BAAQMD] 3a. Compliance with applicable SCAQMD Regulation XI Rules, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR [SCAQMD] 3b. Use of Super Clean Materials (< 5% VOC by weight); OR [SCAQMD] 3c. Use of low-VOC materials resulting in an equivalent emission reduction [SCAQMD]
NOx	1. For booth heaters: < 1,200 °F: 30 ppm or 0.036 lb/MMBtu ≥ 1,200 °F: 60 ppm or 0.073 lb/MMBtu. [SCAQMD, SMAQMD] 2. No Standard – [SDCAPCD, BAAQMD, SJVAPCD, US EPA]
SOx	1. No Standard – [SMAQMD, SCAQMD, SDCAPCD, BAAQMD, SJVAPCD]

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash. HVLP spray or equivalent application equipment(B) – [SMAQMD] 2. Spray booth equipped with overspray filters – [SDCAPCD] 3. Dry filters or waterwash, properly maintained – [SCAQMD, BAAQMD]
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash. HVLP spray or equivalent application equipment(B) – [SMAQMD] 2. Spray booth equipped with overspray filters [SDCAPCD] 3. No Standard – [SCAQMD, BAAQMD, SJVAPCD]
CO	1. For heaters: 400 ppm corrected to 3% O_2 – [SMAQMD] 2. For heaters: 1,000 ppm corrected to 3% O_2 – [SCAQMD]
Organic HAP/VHAP (T-BACT)	<u>For booths without add-on controls</u> 1. HVLP spray or equivalent application equipment(B) 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content to 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard). [SMAQMD] <u>For booths with add-on controls</u> 1. HVLP spray or equivalent application equipment(B) 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content of 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard). With VOC control system with overall capture/destruction efficiency ≥ 90%; OR 6. Use of Super Clean Materials (< 5% VOC by weight); OR 7. Use of low-VOC materials resulting in an equivalent emission reduction as option #5 and option #6. [SMAQMD]
Inorganic HAP (T-BACT)	Compliance with 40 CFR 63 Subpart HHHHHH for metals – Spray booth filter system with 98% capture efficiency of paint overspray, HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology [US EPA]

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

(B) Due to HVLP not being technologically feasible with high viscosity coatings, an application equipment exemption for coatings with a 650 centipoise or greater application will be included in the BACT Determination, similar to SCAQMD coating rules.

The following control technologies have been identified as the most stringent, achieved in practice control technologies:

BEST CONTROL TECHNOLOGIES ACHIEVED		
Pollutant	**Standard**	**Source**
VOC	<u>For booths without add-on Control < 5,475 lb/year VOC Emissions</u> 1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard (275 g/l) and for Etching Filler use SJVAPCD Rule 4603's General Coating Limits). <u>For booths with add-on Control ≥ 5,475 lb/year VOC Emissions</u> 1. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard), and VOC control system with overall capture/destruction efficiency ≥ 90%; OR 2. Use of Super Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction as option #1 and option #2.	SMAQMD, SCAQMD, SJVAPCD, BAAQMD
NOx	<u>For booth heater:</u> < 1200 °F: 30 ppm or 0.036 lb/MMBtu corrected to 3% O_2 ≥ 1200 °F: 60 ppm or 0.073 lb/MMBtu corrected to 3% O_2	SMAQMD, SCAQMD
SOx	No standard	
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment	SMAQMD, SCAQMD, SDAPCD, BAAQMD, SJVAPCD
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment	SDCAPCD
CO	For heaters: 400 ppm corrected to 3% O_2	SMAQMD

BEST CONTROL TECHNOLOGIES ACHIEVED		
Pollutant	**Standard**	**Source**
Organic HAP/VHAP	<u>For booths without add-on Control < 5,475 lb/year VOC Emissions</u> 1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content to 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard). <u>For booths with add-on Control ≥ 5,475 lb/year VOC Emissions</u> 1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content of 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard). With VOC control system with overall capture/destruction efficiency ≥ 90%; OR 6. Use of Super Clean Materials (< 5% VOC by weight); OR 7. Use of low-VOC materials resulting in an equivalent emission reduction as option #5 and option #6	SMAQMD, SCAQMD, SJVAPCD, BAAQMD, US EPA (NV-0049)
Inorganic HAP	Compliance with 40 CFR 63 Subpart HHHHHH for metals – Spray booth filter system with 98% capture efficiency of paint overspray, HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology	USEPA

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

B. TECHNOLOGICALLY FEASIBLE AND COST EFFECTIVE (Rule 202, §205.1.b.):

Technologically Feasible Alternatives:
Any alternative basic equipment, fuel, process, emission control device or technique, singly or in combination, determined to be technologically feasible by the Air Pollution Control Officer.

The table below shows the technologically feasible alternatives identified as capable of reducing emissions beyond the levels determined to be "Achieved in Practice" as per Rule 202, §205.1.a.

Pollutant	Technologically Feasible Alternative
VOC	A. Carbon Adsorber B. Thermal Oxidizer
NOx	No other technologically feasible option identified
SOx	No other technologically feasible option identified
PM10	No other technologically feasible option identified
PM2.5	No other technologically feasible option identified
CO	No other technologically feasible option identified

Cost Effective Determination:
After identifying the technologically feasible control options, a cost analysis is performed to take into consideration economic impacts for all technologically feasible controls identified.

Maximum Cost per Ton of Air Pollutants Controlled

A control technology is considered to be cost-effective if the cost of controlling one ton of that air pollutant is less than the limits specified below:

Pollutant	Maximum Cost ($/ton)
VOC	25,300
NO_X	35,300
PM10	11,400
SO_X	18,300
CO	300

Cost Effectiveness Analysis Summary

This BACT determination will perform a cost effectiveness analysis in accordance with the updated EPA OAQPS Air Pollution Control Cost Manual. The electricity (11.24 cents/kWh) and natural gas (9.75 dollars/1,000 cubic feet) rates were based on an industrial application as approved by the District. The life of the equipment was based on the EPA cost manual recommendation. The interest rate was based on the previous 6-month average interest rate on United States Treasury Securities (based on the life of the equipment) and addition of two percentage points and rounding up to the next higher integer rate. The labor (Occupation Code 51-8099: Plant and System Operators - Other) and maintenance (Occupation Code 49-

2094: electrical and electronics commercial and industrial equipment repairers) rates were based on data from the Bureau of Labor Statistics.

A. Carbon Adsorber:

As shown in Attachment B, the cost effectiveness for the add on carbon adsorber system to control VOC was calculated to be **$25,391/ton** (see attached Paint Spray Booth for General Coating Cost Effectiveness Analysis). The following basic parameters were used in the analysis.

Equipment Life = 15 years

Total Capital Investment = $366,297

Direct Annual Cost = $13,274 per year

Indirect Annual Cost = $59,395 per year

Total Annual Cost = $70,828 per year

VOC Removed = 2.789 tons per year

Cost of VOC Removal = $25,393 per ton reduced

A detailed calculation of the cost effectiveness for VOC removal with a carbon absorber is shown in Attachment A. **Uncontrolled** VOC emissions of **6,198 lb/year** or greater is the cost-effective threshold for control equipment using carbon absorption control technology.

B. Thermal Oxidizer:

As shown in Attachment B, the cost effectiveness for the add on thermal oxidize system to control VOC was calculated to be **$25,436/ton** (see attached Paint Spray Booth for General Coating Cost Effectiveness Analysis). The following basic parameters were used in the analysis.

Equipment Life = 20 years

Direct Cost = $1,034,666

Direct Annual Cost = $77,753 per year

Indirect Annual Cost = $183,111 per year

Total Annual Cost = $260,864 per year

VOC Removed = 10.256 tons per year

Cost of VOC Removal = $25,436 per ton reduced

A detailed calculation of the cost effectiveness for VOC removal with a thermal oxidizer is shown in Attachment B. **Uncontrolled** VOC emissions of **20,824 lb/year** or greater is the cost-effective threshold for control equipment using thermal oxidation control technology.

Conclusion: In this analysis, different emission operating levels are presented with the corresponding total cost per ton of VOC controlled using either a carbon adsorption control or

a thermal oxidizer. Uncontrolled VOC emission level of 6,198 lb per year or greater must be reached in order for the carbon adsorption control option to be cost effective. Uncontrolled VOC emission level of 20,824 lb per year or greater must be reached in order for a thermal oxidizer to be cost effective. The emissions level for the cost effectiveness of controls is based on the District cost effective limit for VOC of $25,300 per ton controlled.

With EPA's cost data, the highest allowable uncontrolled emission rate to not require add-on control devices will be updated to 6,198 lb/year based on the cost of carbon adsorption.

C. SELECTION OF BACT AND T-BACT:

Based on the above analysis, BACT for VOC, NOx, SOx, PM10, PM2.5 and CO will be the most stringent standards of what is currently achieved in practice. Add-on control thresholds of 6,198 lbs VOC/year per unit and 40,000 lbs VOC/year per facility are based on the carbon adsorber cost effectiveness analysis and SCAQMD's Rule 1132 40,000 lb per year threshold for add-on control, respectively.

T-BACT for Misc. Metal Parts and Products Coatings has been separated into T-BACT #336 for units without add-on control and T-BACT #337 for units with add-on control.

BACT #336 – Miscellaneous Metal Parts and Products Coatings < 6,198 lbs VOC/year and facilities ≤ 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
VOC	1. < 6,198 lb VOC/year limit 2. HVLP spray or equivalent application equipment 3. Enclosed spray gun cleaning system 4. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard (275 g/l) and for Etching Filler use SJVAPCD Rule 4603 General Coating Limits).	SMAQMD, SCAQMD, SJVAPD
NOx	For booth heaters: < 1,200 °F: 30 ppmvd @ 3% O_2 or 0.036 lb/MMBtu ≥ 1,200 °F: 60 ppmvd @ 3% O_2 or 0.073 lb/MMBtu	SMAQMD, SCAQMD
SOx	No standard	SMAQMD
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment	SMAQMD
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment	SMAQMD
CO	For heaters: 400 ppmvd @ 3% O_2 or 0.30 lb/MMBtu	SMAQMD

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

T-BACT #336 – Miscellaneous Metal Parts and Products Coatings < 6,198 lbs VOC/year and facilities ≤ 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
Organic HAP/VHAP (T-BACT)	1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content to 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard).	SMAQMD
Inorganic HAP (T-BACT)	Compliance with 40 CFR 63 Subpart HHHHHH for metals – Spray booth filter system with 98% capture efficiency of paint overspray, HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology	US EPA

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.
(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

BACT #337 – Miscellaneous Metal Parts and Products Coatings ≥ 6,198 lb VOC/year and facilities > 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
VOC	1. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard), and VOC control system with overall capture/destruction efficiency ≥ 90%; OR 2. Use of Super Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction as option #1 and option #2.	SMAQMD, SCAQMD, SJVAPCD, BAAQMD
NOx	For booth heaters: < 1,200 °F: 30 ppmvd @ 3% O_2 or 0.036 lb/MMBtu ≥ 1,200 °F: 60 ppmvd @ 3% O_2 or 0.073 lb/MMBtu	SMAQMD, SCAQMD
SOx	No standard	
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment	SMAQMD, SCAQMD, SDAPCD, BAAQMD, SJVAPCD
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash 2. HVLP spray or equivalent application equipment	SDCAPCD
CO	For heaters: 400 ppmvd @ 3% O_2 or 0.30 lb/MMBtu	SMAQMD

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC

content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

T-BACT #337 – Miscellaneous Metal Parts and Products Coatings ≥ 6,198 lb VOC/year and facilities > 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
Organic HAP/VHAP (T-BACT)	1. HVLP spray or equivalent application equipment 2. Enclosed spray gun cleaning system 3. Keep VOC-containing materials in closed containers 4. Limit of organic HAP content of 47% by weight of VOC content 5. Compliance with SMAQMD Rule 451(A)(B) coating, solvent, and stripper standards except for 2 coating categories (For General – One Component use SCAQMD Regulation XI, Rule 1107 standard and for Etching Filler use SJVAPCD Rule 4603 Standard). With VOC control system with overall capture/destruction efficiency ≥ 90%; OR 6. Use of Super Clean Materials (< 5% VOC by weight); OR 7. Use of low-VOC materials resulting in an equivalent emission reduction as option #5 and option #6	SMAQMD, SCAQMD, SJVAPCD, BAAQMD, US EPA (NV-0049)
Inorganic HAP (T-BACT)	Compliance with 40 CFR 63 Subpart HHHHHH for metals – Spray booth filter system with 98% capture efficiency of paint overspray, HVLP spray equipment, electrostatic application, airless spray gun, air-assisted airless spray gun, or an equivalent technology	US EPA

(A) Compliance with SMAQMD Rule 451 includes the use of exemptions of this rule. BACT VOC content limits are exempt if the operation qualifies for VOC content limit exemptions of SMAQMD Rule 451.

(B) This BACT includes an application equipment exemption for coatings with a viscosity of 650 centipoise or greater, as applied.

APPROVED BY: *Brian F Krebs* **DATE:** 01-26-2024

Attachment A

Review of BACT Determinations published by EPA

List of BACT determinations published in EPA's RACT/BACT/LAER Clearinghouse (RBLC) for Misc. Metal Parts and Products Surface Coating (Process Code 41.013):

Mis. Metal Parts and Products Surface Coating (Process Code 41.013)(A)(B)							
RBLC#	**Permit Date[(A)]**	**Throughput**	**Process/ Equipment**	**Pollutant**	**Standard**	**Control Technology**	**Case-By-Case Basis**
OH-0371	9/26/2017	60 TPY	Steel Door Coating	VOC	3.5 lb VOC/gal, excluding water, and exempt solvents, as applied for extreme performance coating	VOC content restrictions, VOC input limitations, and the use of a flow coater	BACT-PSD
NV-0049	8/20/2009	41.013	Paint Spray Booth	HAP	N/A	BACT consists of those described in the process and the limit of HAP content to 47% of the VOC content	Other Case-by-Case

(A) Due to the large number of entries only determinations made (based on Permit Date) entered since 01/01/2009 are included in the above table.
(B) BACT Determinations with "Compliance Verified" listed as "Unknown" were not considered for BACT.

= Selected as the most stringent BACT determination achieved in practice.

= Selected as the most stringent T-BACT determination.

Attachment B

Cost Effectiveness Determination for Carbon Adsorbers and Thermal Oxidizer

Carbon Adsorber Cost Effectiveness Calculations

Data Inputs

Select the type of carbon adsorber system:	Fixed-Bed Carbon Adsorber with Steam Regeneration

For fixed-bed carbon adsorbers, provide the following information:

Select the type of operation:	Continuous Operation
Select the type of material used to fabricate the carbon adsorber vessels:	Stainless Steel, 304
Select the orientation for the adsorber vessels:	Horizontal

Enter the design data for the proposed Fixed-Bed Carbon Adsorber with Steam Regeneration

Number of operating hours per year (Θ_s)	2,080	hours/year	
Waste Gas Flow Rate (Q)	10,000	acfm (at atmospheric pressure and 77^{o}F)	
VOC Emission Rate (m_{voc})	2.980	lbs/hour	
Required VOC removal efficiency (E)	90	percent	
Superficial Bed Velocity (v_b)	75.00	ft/min	
Estimated equipment life of adsorber vessels and auxiliary Equipment (n)	15	Years*	* 15 years is a default equipment life. User should enter actual value, if known.
Estimated Carbon life (n)	5	Years	
Total Number of carbon beds (N_{total})	3	Beds*	* 3 beds is the default. User should enter actual number of beds, if known.
Number of carbon beds adsorbing VOC when system is operating (N_A)	2	Beds*	* 2 beds is the default. User should enter actual number of beds, if known.
Total time for adsorption (Θ_A)	12	hours*	* 12 hours is a default value. User should enter actual value, if known.
Total time for desorption (Θ_D)	5	hours*	* 5 hours is a default value. User should enter actual value, if known.
Estimated Carbon Replacement Rate (CRR)	379	lbs/hour*	* 379 lbs./hour is a default value. User should enter actual value, if known.

Enter the Characteristics of the VOC/HAP:

Name of VOC/HAP	Toluene	
Partial Pressure of Toluene in waste gas stream	0.0104	psia
Parameter "k" for Toluene	0.551	**Note:**
Parameter "m" for Toluene	0.110	Typical values of "k" and "m" for some common VOCs are shown in Table A.

Enter the cost data for the carbon adsorber:

Desired dollar-year	2023			
CPI for 2023	305.69	CPI value for Jul. 2023	168.9	1999
Annual Interest Rate (i)	6	percent (Current bank prime rate)		

Electricity (P_{elec})	$0.1124	per kWh	
Steam (P_s)	$5.00	per 1,000 lbs*	* $5.00/1,000 lbs is a default value. User should enter actual value, if known.
Cooling Water (P_{cw})	$3.55	per 1,000 gallons of water*	* $3.55/1,000 gallons is a default value. User should enter actual value, if known.
Operator Labor Rate	$27.48	per hour*	* $27.48/hour is a default value. User should enter actual value, if known.
Maintenance Labor Rate	$30.23	per hour*	* $30.23/hour is a default value. User should enter actual value, if known. If the rate is not kno
Carbon Cost (CC)	$4.20	per lb	* $4.20/lb is a default value based on 2018 market price. User should enter actual value, if kno
Re-Sale Value of Recovered VOC (P_{voc})	$0.33	per lb*	* $0.33/lb is a default value for recovered toluene based on 2018 data. User should enter actua
Disposal/Treatment Cost for Recovered VOC (D_{voc})	$0.00	per lb*	* $0/lb is a default value for disposal and/or treatment of recovered VOC/HAP. User should ent

If known, enter any additional costs for site preparation and building construction/modification:

Site Preparation (SP) =	$0	* Default value. User should enter actual value, if known.
Buildings (Bldg) =	$0	* Default value. User should enter actual value, if known.
Equipment Costs for auxiliary equipment (e.g., ductwork, dampers, and stack) (EC_{aux}) =	$32,000	* Default value. User should enter actual value, if known.
Contingency Factor (CF)	10.0	percent* * 10 percent is a default value. The contingency factor should be between 5 and 15 percent.

Design Parameters

The following design parameters for the carbon adsorber were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Type of Carbon Adsorber:	**Fixed-Bed Carbon Adsorber with Steam Regeneration**
Name of VOC Controlled:	**Toluene**

Parameter	Equation	Calculated Value	Units
Quantity of Toluene Recovered:			
Quantity of Toluene Recovered (Wvoc) =	$W_{voc} = m_{voc} \times \Theta_s \times E$ =	2.789	tons/year
Time required for Desorption (Θ_D) =		5	hours
Time for Adsorption (Θ_A) =		12	hours
Time Available for Desorption =	$\Theta_A (N_D/N_A)$ =	6	hours
Adsorber Parameters:			
Equilibrium Capacity at the Inlet ($W_{e(max)}$) =	$k \times P^m$ =	0.333	lb. VOC/lb. Carbon
Working Capacity (w_c) =	0.5 x $w_{e(max)}$ =	0.167	lb. VOC/lb. Carbon
Adjustment Factor for Adorber Vessel Material (F_m) =		1.0	(* Stainless Steel, 304)
Number of Bed Desorbing (N_D) =	$N_{total} - N_A$ =	1	Bed
Number of Bed Adsorbing (N_A) =		2	Bed
Volumetric Flow Rate for each Vessel (Q') =	Q/N_A =	5,000	acfm/Bed
Carbon Bed Thickness (t_b) =	$(M_c'/\rho_b)/(Q'/v_b)$, where the density of carbon (ρb) = 30 lb/sq.ft	0.05	ft.
Pressure Drop (ΔP_s) =	$t_b \times (0.03679 v_b + 1.107 \times 10^{-4} v_b^2) + 1$ =	1.18	inches
Cooling Fan Operating Time (Θ_{cf}) =	0.4 x Θ_D x $(N_A \times \Theta_s)/\Theta_A$ =	693	hours
Estimated Carbon Required:			
Estimated Carbon Consumption (M_c) for a continuously operated system =	$(m_{voc}/w_c) \times \Theta_A (1 + N_D/N_A)$ =	322	lbs.
Carbon Required for each Vessel (M_c') =	$M_c/(N_A + N_D)$ =	107	lbs./Bed
Estimated Adsorber Vessel Dimensions and Surface Area:			
Vessel Orientation =		Horizontal	
Vessel Diameter (D) =	$(0.127 \times M_c' \times v_b)/Q'$ =	0.20	ft.
Vessel Length (L) =	$(7.87/Mc') \times (Q'/v_b)^2$ =	326.15	ft.
Surface Area of Adsorber Vessel (S) =	$\pi \times D \times (L+D/2)$ =	209	sq.ft
Electricity Consumption:			
Electricity Consumed by the system fan (Q_{sf}) =	$(0.746 kW/hp) \times 2.5 \times 10^{-4} \times Q \times \Delta P_s \times \Theta_s$ =	4,583	kWh/year
Electricity Consumed by the cooling fan (Q_{cf}) =	$(0.746 kW/hp) \times 2.5 \times 10^{-4} \times Q_{cf} \times \Delta P_s \times \Theta_{cf}$ =	458	kWh/year
Electricity Consumed by the Cooling Water Fan (Q_{cwf}) =	$(0.746 kW/hp) \times [2.52 \times 10^{-4} \times 100/\eta] \times [\Theta_{cwp}/(0.6 \times \Theta_D \times N_A \times \Theta_D/\Theta_A) \times 60 mins/hour]$ =	128	kWh/year
Total Estimated Electricity Consumption (Q_{Elec}) =	Qsf + Qcf + Qcsf =	5,169	kWh/year
Steam Consumption:			
Total Steam Consumption (Q_{Steam}) =	= 3.5 x M_{voc} x Θ_s =	21,694	lbs./year
Cooling Water Consumption:			
Total Cooling Water Consumption (Q_{cw}) =	= 3.43 x C_s/P_s =	74,412	gallons/year
Capital Recovery Factor:			
Capital Recovery Factor for adsorber vessels and auxiliary equipment (CFRAbsorber)=	$[i \times (1 + i)^n] / [(1 + i)^n - 1]$ = Where n = Equipment Life and i = Interest Rate	0.1030	
Capital Recovery Factor for carbon (CRF_{Carbon}) =	$[i \times (1 + i)^n] / [(1 + i)^n - 1]$ = Where n = Carbon Life and i = Interest Rate	0.2374	

Cost Estimate

Capital Costs

Estimated capital costs for a Fixed-Bed Carbon Adsorber with Steam Regeneration with the following characteristics:

VOC Controlled/Recovered = Toluene
Adsorber Vessel Orientation = Horizontal
Operating Schedule = Continuous Operation

Total Capital Investment (TCI) (in 2023 dollars)

Parameter	Equation	Cost
Costs for Each Carbon Adsorber Vessel (C_v) =	$271 \times F_m \times S^{0.778}$ =	$31,357
Total Cost for All Carbon Adsorber Vessels and Carbon(EC_{Adsorb}) =	$5.82 \times Q^{-0.133} \times [C_c + (N_A + N_D) \times C_v]$ =	$163,146
Auxiliary Equipment (EC_{aux}) =	(Based on design costs or estimated using methods provided in Section 2)	$32,000
Total Purchased Equipment Costs for Carbon Adsorber (A) =	= $EC_{Adsorb} + EC_{aux}$ =	$195,146
Instrumentation =	0.10 × A =	Included in A
Sales taxes =	0.03 × A =	$5,854
Freight =	0.05 × A =	$9,757
	Total Purchased Equipment Costs (B) =	$210,758

Direct Installation Costs (in 2023 dollars)

Parameter	Equation	Cost
Foundations and Supports =	0.08 × B =	$16,861
Handling and Erection =	0.14 × B =	$29,506
Electrical =	0.04 × B =	$8,430
Piping =	0.02 × B =	$4,215
Insulation =	0.01 × B =	$2,108
Painting =	0.01 × B =	$2,108
Site Preparation (SP) =		$0
Buildings (Bldg) =		$0
	Total Direct Costs (DC) = B + (0.3 × B) + SP + Bldg =	$273,985

Total Indirect Installation Costs (in 2023 dollars)

Parameter	Equation	Cost
Engineering =	0.10 × B =	$21,076
Construction and field expenses =	0.05 × B =	$10,538
Contractor fees =	0.10 × B =	$21,076
Start-up =	0.02 × B =	$4,215
Performance test =	0.01 × B =	$2,108
	Total Indirect Costs (IC) =	$59,012
Contingency Cost (C) =	CF(IC+DC)=	$33,300

Total Capital Investment (TCI) =	**DC + IC + C = (1.28 × B) + SP + Bldg. + C =**	**$366,297**	**in 2023 dollars**

Annual Costs

Direct Annual Costs

Parameter	Equation	Cost	
Annual Electricity Cost =	$Q_{Elec} \times P_{elec}$ =	$581	
Annual Steam Cost (C_s) =	$3.50 \times m_{voc} \times \Theta_s \times P_s$ =	$108	
Annual Cooling Water Cost (C_{cs}) =	$3.43 \times C_s/P_s \times P_{wc}$ =	$264	
Operating Labor Costs:	Operator = 0.5 hours/shift × Labor Rate × (Operating hours/8 hours/shift)	$3,572	
	Supervisor = 15% of Operator	$536	
Maintenance Costs:	Labor = 0.5 hours/shift × Labor Rate × (Operating Hours/8 hours/shift)	$3,930	
	Materials = 100% of maintenance labor	$3,930	
Carbon Replacement Costs:	Labor = CRF_{carbon} x (Labor Rate × M_c)/CRR =	$6	
	Carbon = CRF_{carbon} x CC x M_c x 1.08 =	$346	

Direct Annual Costs (DAC) =		**$13,274**	**in 2023 dollars**

Indirect Annual Costs

Parameter	Equation	Cost
Overhead	= 60% of sum of operator, supervisor, maintenance labor Plus maintenance materials	$7,181
Administrative Charges	= 2% of TCI	$7,326
Property Taxes	= 1% of TCI	$3,663
Insurance	= 1% of TCI	$3,663
Capital Recovery	= $CRF_{Adsorber}$ × (TCI - [(1.08 x CC x M_c) + (LR x M_c/CRR)] =	$37,562

Indirect Annual Costs (IAC) =		**$59,395**	**in 2023 dollars**

Recovered Solvent Credit/Disposal Costs

Disposal Cost

Parameter	Equation	Cost
VOC Disposal/Treatment Costs (*Disposal $_{cost}$*)	$= m_{voc} \times \Theta_s \times D_{voc} \times E =$	$0

VOC Recovery Credit

Parameter	Equation	Cost
Annual Recovery Credit for Condensate (RC)	$= m_{voc} \times \Theta_s \times P_{voc} \times E =$	$1,841

Total Annual Cost (TAC) =	**DAC + IAC + C + Disposal$_{Cost}$ - RC =**	**$70,828**	**in 2023 dollars**

Cost Effectiveness

Cost Effectiveness

Parameter	Equation	Cost	
Total Annual Cost =	TAC =	$70,828	per year in 2023 dollars
Annual Quantity of VOC Removed/Recovered =	$W_{voc} = m_{voc} \times \Theta_s \times E =$	2.789	tons/year
Cost Effectiveness =	Total Annual Cost (TAC) / Annual Quantity of VOC Removed/Recovered =	$25,392.94	per ton of pollutants removed/recovered in 2023 dollars

Oxidizer Cost Effectiveness Calculations

Data Inputs

Select the type of oxidizer: Regenerative Thermal Oxidizer

Enter the following information for your emission source:

Composition of Inlet Gas Stream

Pollutant Name	Concentration (ppmv)	Lower Explosive Limit (LEL) (ppmv)*	Heat of Combustion (Btu/scf)	Molecular Weight
Toluene	35	11,000	4,274	92.13

Note: The lower explosion limit (LEL), heat of combustion and molecular weight for some commonly used VOC/HAP are provided in the table below.

Enter the design data for the proposed oxidizer:

Number of operating hours/year	2,080	hours/year	
Inlet volumetric flow rate(Q_{wi}) at 77°F and 1 atm.	20,000	scfm*	* 20,000 scfm is a default volumetric flow rate. User should enter actual value, if known.
Inlet volumetric flow rate(Q_{wi}) (actual conditions)	20,900	acfm*	* 20,900 acfm is a default volumetric flow rate. User should enter actual value, if known.
Pressure drop (ΔP)	19	inches of water	* 23 inches of water is the default pressure drop for thermal oxidizers; 19 inches of water is the default pressure drop for catalytic oxidizers. Enter actual value, if known.
Motor/Fan Efficiency (ε)	60	percent*	* 60% is a default fan efficiency. User should enter actual value, if known.
Inlet Waste Gas Temperature (T_{wi})	77	°F	
Operating Temperature (T_{fi})	1,900	°F	* Note: Default value for Tfi is 2000°F for thermal regenerative oxidizers. Use actual value if known. Tfi for regenerative oxidizers typically between 1800 and 2000°F.
Destruction and Removal Efficiency (DRE)	98.5	percent	
Estimated Equipment Life	20	Years*	* 20 years is the typical equipment life. User should enter actual value, if known.
Heat Loss (η)	1	percent*	* 1 percent is a default value for the heat loss. User should enter actual value, if known. Heat loss is typically between 0.2 and 1.5%.

Percent Energy Recovery (HR) = 70 percent

Enter the cost data:

Desired dollar-year	2023			
CPI for 2023	305.69	Enter the CPI value for Jul. 2023	247.705	2016 CPI
Annual Interest Rate (i)	6	Percent		
Electricity ($Cost_{elect}$)	0.1124	$/kWh		
Natural Gas Fuel Cost ($Cost_{fuel}$)	0.00975	$/scf		
Operator Labor Rate	$27.48	per hour		
Maintenance Labor rate	$30.23	per hour		
Contingency Factor (CF)	10.0	Percent		

* 10 percent is a default value for construction contingencies. User may enter values between 5 and 15 percent.

Design Parameters

The following design parameters for the oxidizer were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Composition of Inlet Gas Stream		
Pollutant Name	Concentration in Waste Stream (ppmv) From Data Inputs Tab	Adjusted Concentration with Dilution Air (ppmv)
Toluene	35	NA
0	0	NA
0	0	NA
0	0	NA
0	0	NA
0	0	NA
0	0	NA
0	0	NA
0	0	NA
0	0	NA
Total	35	0

Constants used in calculations:

Temperature of auxiliary fuel (T_{af}) =	Reference Temperature (T_{ref}) =	77.0	°F
Density of auxiliary Fuel at 77 °F (ρ_{af}) =		0.0408	lb/ft^3
Heat Input of auxiliary fuel ($-\Delta h_{caf}$) =		21,502	Btu/lb
Density of waste gas at 77 °F (ρ_{wi}) =		0.0739	lb/ft^3
Mean Heat Capacity of Air (C_{pmair})	(For thermal oxidizers)	0.255	Btu/lb °F

Parameter	Equation	Calculated Value	Units	Value	Units
Sum of volume fraction of combustible components =	= ($\sum x_i$) =	35	ppmv		
Lower Explosive Limit of waste gas (LEL_{mix})	= $[\sum((x_j)/((\sum x_i) \times LEL_j))]^{-1}$ =	11,000	ppmv		
	Where x_j is the volume fraction and LEL_j the lower explosive limit for each combustible component in the waste gas.				
% LEL_{mix}	= (Total Combustible Conc. In Mixture/LEL_{mix}) × 100 =	0.32	percent	* Note: Since the LEL of the waste gas stream is below 25%, no dilution air is needed.	
Dilution Factor	= (LEL_{mix} x 0.249)/($\sum x_i$) =	Not applicable			
Lower Explosive Limit (LEL) of waste gas after addition of dilution air	= (Total Adjusted Conc. With Dilution Air/LEL_{mix}) × 100 =	Not Applicable			
Inlet volumetric flow rate(Qwi) at 77°F and 1 atm.	(From Data Inputs Tab) =	20,000	scfm		
Oxygen Content of gas stream	= 100 - ($\sum x_j \times 100/10^6$) x 0.209 =	20.90	percent		
Fan Power Consumption (FP)	= $[(1.17 \times 10^{-4}) \times Q_{wi} \times \Delta P]/\varepsilon$	77.4	kW		
Q_{wo}	≈ Q_{wi} =	20,000	scfm		
Operating temperature of oxidizer (T_{fi})	(From Data Inputs Tab)	1,900	°F		
Temperature of waste gas at outlet to preheater (T_{wo})	= Heat Recovery × (T_{fi} - T_{wi}) + T_{wi} =	1,353	°F		
Temperature of flue gas exiting the regenerative oxidizer (T_{fo})	= T_{fi} - 0.95(T_{fi} - T_{wi}) =	168	°F		

Heat Input of waste gas ($-\Delta h_{cwi}$)				
	$= \sum (-\Delta h_{ci})\, x_i$			
	Where $(-\Delta h_{ci})$ is the heat of combustion and x_i the fraction of component "i" at 77 °F.	0.15	Btu/scf	2.0 Btu/lb
Estimated Auxiliary Fuel Flow (Q_{af}) at 77 °F and 1 atm.	(Calculated using Equation 2.45 in Appendix B)	13.77	scfm	
Auxiliary fuel Energy Input =		12,077	Btu/min	
Minimum Energy required for combustion stabilization =	$= 5\% \times$ Total Energy Input $= 0.05 \times \rho_{fi} \times Q_{fi} \times C_{pmfi} \times (T_{fi} - T_{ref}) =$	34,377	Btu/min	
Is the calculated auxiliary fuel sufficient to stabilize combustion? (Note: If the auxiliary fuel energy input > 5% of Total Energy Input, then the auxilary fuel is sufficient.)		No		Note: Additional auxiliary fuel equivalent to 5% of total energy input is required to stabilize combustion.
Auxiliary fuel flow (Qaf) (adjusted for fuel required for combustion stabilization)at 77°F and 1 atm. =		39	scfm	
Total Volumetric Throughput (Q_{tot}) at 77 °F and 1 atm.	$= Q_{fi} = Q_{wo} + Q_a + Q_{af} = Q_{wi} + Q_{af} =$	20,039	scfm	

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	$i\,(1+i)^n/(1+i)^n - 1 =$	0.0872
	Where n = Equipment Life and i= Interest Rate	

Cost Estimate

Direct Costs		
Total Purchased equipment costs (in 2023 dollars)		
Incinerator + auxiliary equipment[a] (A) =		
Equipment Costs (EC) for Regenerative Oxidizer	=[2.664 x 100,000 + (13.98 x Qtot)] x (2023 CEPI/2016 CEPCI) =	$674,489 in 2023 dollars
Instrumentation[b] =	0.10 × A =	$67,449
Sales taxes =	0.03 × A =	$20,235
Freight =	0.05 × A =	$33,724
	Total Purchased equipment costs (B) =	$795,897 in 2023 dollars

Footnotes

a - Auxiliary equipment includes equipment (e.g., duct work) normally not included with unit furnished by incinerator vendor.

b - Includes the instrumentation and controls furnished by the incinerator vendor.

Direct Installation Costs (in 2023 dollars)		
Foundations and Supports =	0.08 × B =	$63,672
Handlong and Errection =	0.14 × B =	$111,426
Electrical =	0.04 × B =	$31,836
Piping =	0.02 × B =	$15,918
Insulation for Ductwork =	0.01 × B =	$7,959
Painting =	0.01 × B =	$7,959
Site Preparation (SP) =		$0
Buildings (Bldg) =		$0
	Total Direct Installaton Costs =	$238,769
Total Direct Costs (DC) =	Total Purchase Equipment Costs (B) + Total Direct Installation Costs =	$1,034,666 in 2023 dollars

Total Indirect Installation Costs (in 2023 dollars)		
Engineering =	0.10 × B =	$79,590
Construction and field expenses =	0.05 × B =	$39,795
Contractor fees =	0.10 × B =	$79,590
Start-up =	0.02 × B =	$15,918
Performance test =	0.01 × B =	$7,959
	Total Indirect Costs (IC) =	$222,851
Continency Cost (C) =	CF(IC+DC)=	$125,752
Total Capital Investment =	**DC + IC +C =**	**$1,383,268 in 2023 dollars**

Direct Annual Costs		
Annual Electricity Cost	= Fan Power Consumption × Operating Hours/year × Electricity Price =	$18,104
Annual Fuel Costs for Natural Gas	= $Cost_{fuel}$ × Fuel Usage Rate × 60 min/hr × Operating hours/year	$47,682
Operating Labor	Operator = 0.5hours/shift × Labor Rate × (Operating hours/8 hours/shift)	$3,572
	Supervisor = 15% of Operator	$536
Maintenance Costs	Labor = 0.5 hours/shift × Labor Rate × (Operating Hours/8 hours/shift)	$3,930
	Materials = 100% of maintenance labor	$3,930
Direct Annual Costs (DC) =		**$77,753 in 2023 dollars**

Indirect Annual Costs		
Overhead	= 60% of sum of operating, supervisor, maintenance labor and maintenance materials	$7,181
Administrative Charges	= 2% of TCI	$27,665
Property Taxes	= 1% of TCI	$13,833
Insurance	= 1% of TCI	$13,833
Capital Recovery	= CRF[TCI-1.08(cat. Cost)]	$120,600
Indirect Annual Costs (IC) =		**$183,111 in 2023 dollars**

Total Annual Cost =	**DC + IC =**	**$260,864 in 2023 dollars**

Cost Effectiveness

Cost Effectiveness = (Total Annual Cost)/(Annual Quantity of VOC/HAP Pollutants Destroyed)

Total Annual Cost (TAC) =	$260,864	per year in 2023 dollars
VOC/HAP Pollutants Destroyed =	10.256	tons/year
Cost Effectiveness =	$25,436	per ton of pollutants removed in 2023 dollars