SMAQMD BACT CLEARINGHOUSE

CATEGORY Type: **COATING - WOOD**

BACT Category: ≤ 7,404 lbs VOC/year

BACT Determination Number: 277	**BACT Determination Date:** 11/19/2020

Equipment Information

Permit Number: N/A -- Generic BACT Determination
Equipment Description: PAINT SPRAY BOOTH
Unit Size/Rating/Capacity: Minor Source BACT
Equipment Location:

EXPIRED

BACT Determination Information

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

ROCs	**Standard:**	
	Technology Description:	1.HVLP spray or equivalent application equipment 2.Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 in BACT Document)
	Basis:	Achieved in Practice
NOx	**Standard:**	
	Technology Description:	For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu
	Basis:	Achieved in Practice
SOx	**Standard:**	
	Technology Description:	No Standard
	Basis:	
PM10	**Standard:**	
	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:**	
	Technology Description:	1.Enclosed spray booth with properly maintained dry filters or waterwash.
	Basis:	Achieved in Practice
CO	**Standard:**	
	Technology Description:	No Standard
	Basis:	
LEAD	**Standard:**	
	Technology Description:	
	Basis:	

Comments: T-BACT is the following:
1.HVLP spray or equivalent application equipment
2.Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent.

Printed: 11/19/2021

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Equipment Location:

EXPIRED

BACT Determination Information

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

ROCs	**Standard:**	
	Technology Description:	1. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 in BACT Document) and VOC control system with ≥90% collection efficiency and ≥ 95% destruction efficiency; OR
	Basis:	Achieved in Practice
NOx	**Standard:**	
	Technology Description:	For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu
	Basis:	Achieved in Practice
SOx	**Standard:**	
	Technology Description:	No Standard
	Basis:	
PM10	**Standard:**	
	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:**	
	Technology Description:	1.Enclosed spray booth with properly maintained dry filters or waterwash.
	Basis:	Achieved in Practice
CO	**Standard:**	
	Technology Description:	No Standard
	Basis:	
LEAD	**Standard:**	
	Technology Description:	
	Basis:	

Comments: T-BACT is the following:

1.Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63.

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777 12th Street, Ste 300

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Sacramento, CA 95814

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

DETERMINATION NO.: 277 & 278

DATE: November 19, 2021

ENGINEER: Jeffrey Quok

EXPIRED

Category/General Equip Description: Coating, Stripping, and Solvent Cleaning – Wood

Equipment Specific Description: Paint Spray Booth

Equipment Size/Rating:
≤ 7,404 lbs VOC/year per booth and facility emissions ≤ 40,000 lbs VOC/year (BACT #277)

> 7,404 lbs VOC/year per booth and facility emissions ≤ 40,000 lbs VOC/year (BACT #278)

Previous BACT Det. No.: 190 & 191

This BACT determination will update Determinations #190 & #191 for paint spray booths used for wood coating operations at facilities that emit . This BACT determination will also include stripping and solvent cleaning operations related to wood coating operations. Coatings are material applied to a surface and which forms a film in order to beautify and/or protect such a surface. Coatings are often applied in paint spray booth using equipment such as spray guns. This BACT determination only applies to facilities that emit ≤ 40,000 lbs VOC/year.

BACT/T-BACT ANALYSIS

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

The following control technologies are currently employed as BACT/T-BACT for paint spray booths used for wood coating operations by the following air pollution control districts:

US EPA

BACT
Source: EPA RACT/BACT/LAER Clearinghouse
RBLC ID: VA-0300 (12/15/2006)

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

Paint Spray Booth, Wood Coating (RBLC ID: VA-0300)	
VOC	Proper spraying techniques and the use of high solids coatings whenever possible.
NOx	N/A – No BACT determinations
SOx	N/A – No BACT determinations
PM10	Dry filters, proper spray techniques, and work practice standards of 40 CFR 63 subpart JJ. Each filter shall be equipped with a device to continuously measure the differential pressure drop across the filter.
PM2.5	N/A – No BACT determinations
CO	N/A – No BACT determinations

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

RULE REQUIREMENTS:
40 CFR 63 Subpart JJ – National Emission Standards for Wood Furniture Manufacturing Operations
This regulation applies for facilities that are engaged, either in part or in whole, in the manufacture of wood furniture or wood furniture components and that are located at a plant site that is a major source as defined in 40 CFR subpart A, §63.2.

Subpart JJ limits volatile hazardous air pollutants (VHAP) of finishing operations and contact adhesives and also limits the VOC strippable spray booth material. The limits can be seen in the table below.

Table 3 to Subpart JJ of Part 63—Summary of Emission Limits

Emission Point	Existing Source	New Source
Finishing Operations:		
(a) Achieve a weighted average VHAP content across all coatings (maximum kg VHAP/kg solids [lb VHAP/lb solids], as applied	[A]1.0	[A]0.8
(b) Use compliant finishing materials (maximum kg VHAP/kg solids [lb VHAP/lb solids], as applied):		
— stains	[A]1.0	[A]1.0
—washcoats	[A] [B]1.0	[A] [B]0.8
—sealers	[A]1.0	[A]0.8
—topcoats	[A]1.0	[A]0.8
—basecoats	[A] [B]1.0	[A] [B]0.8
—enamels	[A] [B]1.0	[A] [B]0.8
—thinners (maximum percent VHAP allowable); or	10.0	10.0
(c) As an alternative, use control device; or	[C]1.0	[C]0.8

Emission Point	Existing Source	New Source
(d) Use any combination of (a), (b), and (c)	1.0	0.8
Cleaning Operations:		
Strippable spray booth material (maximum VOC content, kg VOC/kg solids [lb VOC/lb solids])	0.8	0.8
Contact Adhesives:		
(a) Use compliant contact adhesives (maximum kg VHAP/kg solids [lb VHAP/lb solids], as applied) based on following criteria:		
i. For aerosol adhesives, and for contact adhesives applied to nonporous substrates	(D)NA	(D)NA
ii. For foam adhesives used in products that meet flammability requirements	1.8	0.2
iii. For all other contact adhesives (including foam adhesives used in products that do not meet flammability requirements); or	1.0	0.2
(b) Use a control device	(E)1.0	(E)0.2
All Finishing Operations and Contact Adhesives:		
(a) Achieve total free formaldehyde emissions across all finishing operations and contact adhesives, lb per rolling 12 month period, as applied	400	400
(b) Use coatings and contact adhesives only if they are low-formaldehyde coatings and contact adhesives	(F)1.0	(F)1.0

(A) The limits refer to the VHAP content of the coating, as applied.
(B) Washcoats, basecoats, and enamels must comply with the limits presented in this table if they are purchased premade, that is, if they are not formulated onsite by thinning other finishing materials. If they are formulated onsite, they must be formulated using compliant finishing materials, i.e., those that meet the limits specified in this table, and thinners containing no more than 3.0 percent VHAP by weight.
(C) The control device must operate at an efficiency that is equivalent to no greater than 1.0 kilogram (or 0.8 kilogram) of VHAP being emitted from the affected emission source per kilogram of solids used.
(D) There is no limit on the VHAP content of these adhesives.
(E) The control device must operate at an efficiency that is equivalent to no greater than 1.0 kilogram (or 0.2 kilogram) of VHAP being emitted from the affected emission source per kilogram of solids used.
(F) The limits refer to the formaldehyde content by weight of the coating or contact adhesive, as specified on certified product data sheets.

40 CFR 63 Subpart QQQQ – National Emission Standards for Surface Coating of Wood Building Products

This regulation applies to wood building product coating operations that use 1,100 gallons of coatings per year or are located at or are part of a major source of Hazardous Air Pollutants (HAPS).

Subpart QQQQ limits hazardous air pollutants (HAP) for surface coating of wood building products. The limits can be seen in the table below.

Table 1 to Subpart QQQQ of Part 63—Emission Limits for New or Reconstructed Affected Sources

You must comply with the emission limits that apply to your affected source in the following table as required by §63.4690.

If the affected source applies coating to products in the following subcategory. . .	Then, the organic HAP emission limit for the affected source, in grams HAP/liter solids (lb HAP/gal solids)[A] [B] is:
1. Exterior siding and primed door skins	0 (0.00)
2. Flooring	0 (0.00)
3. Interior wall paneling or tileboard	5 (0.04)
4. Other interior panels	0 (0.00)
5. Doors, windows, and miscellaneous	57 (0.48)

(A) Determined as a rolling 12-month emission rate according to the requirements in §63.4741, §63.4751, or §63.4761, as applicable.
(B) If the affected source applies coatings to products in more than one of the subcategories listed in the table, then you must determine the applicable emission limit according to §63.4690(c).

Table 2 to Subpart QQQQ of Part 63—Emission Limits for Existing Affected Sources

You must comply with the emission limits that apply to your affected source in the following table as required by §63.4690.

If the affected source applies coating to products in the following subcategory. . .	Then, the organic HAP emission limit for the affected source, in grams HAP/liter solids (lb HAP/gal solids)[A] [B] is:
1. Exterior siding and primed door skins	7 (0.06)
2. Flooring	93 (0.78)
3. Interior wall paneling or tileboard	183 (1.53)
4. Other interior panels	20 (0.17)
5. Doors, windows, and miscellaneous	231 (1.93)

(A) Determined as a rolling 12-month emission rate according to the requirements in §63.4741, §63.4751, or §63.4761, as applicable.
(B) If the affected source applies coatings to products in more than one of the subcategories listed in the table, then you must determine the applicable emission limit according to §63.4690(c).

Air Resources Board (ARB)

BACT
Source: ARB BACT Clearinghouse

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

ARB BACT Clearinghouse	
VOC	No standard
NOx	No standard
SOx	No standard
PM10	No standard
PM2.5	No standard
CO	No standard

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

RULE REQUIREMENTS:
None.

Sacramento Metropolitan AQMD

BACT

BACT Determination #190 & #191 (8/28/2018)

BACT #190: Paint Spray Booth, Wood Coating, ≤ 4,219 lb VOC/year	
VOC	Compliance with SMAQMD Rule 463 and BACT VOC limits and HVLP spray or eqivalent application equipment.
NOx	For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu
SOx	No standard
PM10	Enclosed spray booth with properly maintained dry filters or water wash; HVLP spray or equivalent application equipment
PM2.5	Enclosed spray booth with properly maintained dry filters or waterwash
CO	No standard

BACT #191: Paint Spray Booth, Wood Coating, > 4,219 lb VOC/year	
VOC	Compliance with SMAQMD Rule 463 and BACT VOC limits, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR use of super clean materials (< 5% VOC by weight); OR use of low-VOC materials resulting in an equivalent emission reduction
NOx	For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu
SOx	No standard
PM10	Enclosed spray booth with properly maintained dry filters or water wash; HVLP spray or equivalent application equipment
PM2.5	Enclosed spray booth with properly maintained dry filters or waterwash
CO	No standard

T-BACT

T-BACT Determination #190 & #191 (8/28/2018)

BACT #190: Paint Spray Booth, Wood Coating, ≤ 4,219 lb VOC/year	
HAP/ VHAP	1. HVLP spray or equivalent application equipment 2. Compliance with SMAQMD Rule 463 and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63, emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent.

BACT #191: Paint Spray Booth, Wood Coating, > 4,219 lb VOC/year	
HAP/ VHAP	1. Compliance with SMAQMD Rule 463 and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent. 2. VOC control system with ≥90% collection efficiency and ≥ 95% destruction efficiency; OR 3. Use of Super Clean Materials (<5% VOC by weight); OR 4. Use of low-VOC materials resulting in an equivalent emission reduction

RULE REQUIREMENTS:

Rule 463 (Last amended 9/25/2008)

One of the following methods shall be used when applying wood product coatings to any wood products:

A. Electrostatic spray
B. High-volume low-pressure (HVLP) spray
C. Low-volume low-pressure (LVLP) spray
D. Roll coater, dip coat or flow coat
E. Hand application method, such as brush or roller
F. Air assisted airless, for touch-up and repair only
G. 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 **new wood product**, which has a VOC content exceeding the applicable limits below:

Coating Category (SMAQMD Rule 463 Definition)	**Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/lbs-solid)**
Clear Topcoats	275 (0.35)
Conversion Varnish	550 (1.20)
Filler	275 (0.18)
High-solid stain	350 (0.42)
Inks	500 (0.96)
Mold-seal Coating	750 (4.20)
Multi-colored Coating	275 (0.33)
Pigmented Coating	275 (0.25)
Sealer	275 (0.36)

Coating Category (SMAQMD Rule 463 Definition)	**Maximum Allowable VOC Content grams/liter (lb/gal)**
Low-Solid Stains, Toners, Washcoats	120 (1.00)

VOC content of coatings used for **refinishing, repairing, preserving, or restoring wood products** shall not exceed the following limits:

Coating Category (SMAQMD Rule 463 Definition)	**Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lbs-VOC/lbs-solid)**
Clear Topcoats	680 (2.5)
Conversion Varnish	550 (1.20)
Filler	500 (0.96)
High-solid stain	700 (2.57)
Inks	500 (0.96)
Mold-seal Coating	750 (4.20)
Multi-colored Coating	680 (2.60)
Pigmented Coating	600 (1.60)
Sealer	680 (2.5)

Coating Category (SMAQMD Rule 463 Definition)	**Maximum Allowable VOC Content grams/liter (lb/gal)**
Low-Solid Stains, Toners, Washcoats	480 (4.00)

A person shall not use a stripper on wood products unless:

- It contains 350 grams of VOC per liter of material; or
- The VOC composite partial vapor pressure is 2 mm Hg (0.04 psia) or less at 20°C (68°F), as calculated pursuant to Section 402.

Requirements for Surface Preparation and Cleanup Materials:

- Closed containers shall be used for the disposal of cloth or paper used for surface preparation, cleanup, and coating removal.
- VOC-containing materials shall be stored in containers, which are closed when not in use, and shall be disposed of in a manner that the VOC are not emitted into the atmosphere.
- Effective September 25, 2009, a person shall not perform surface preparation or cleanup with a material containing VOC in excess of 25 grams per liter (0.21 pounds per gallon).

RULE REQUIREMENTS:

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 Combusion 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)**
	Effective (see Section 401)		
Gaseous Fuel-Fired Equipment	**Process Temperature**		**All Temperatures**
	< 1200°F	≥ 1200 °F	
Oven, Dehydrator, Dryer, Heater, or Kiln	30 (0.036)	60 (0.073)	400 (0.30)

South Coast AQMD

BACT
Source: SCAQMD BACT Guidelines for Non-Major Polluting Facilities, page 121.
(Last Revised 2/5/2021)

Spray Booths	
VOC	For non-automotive booths with < 1,170 lbs/month VOC Emissions 1. Compliance with applicable AQMD Regulation XI Rules For non-automotive booths with ≥ 1,170 lbs/month 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 Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction
NOx	No standard
SOx	No standard
PM10	Dry filters or waterwash
PM2.5	No standard
CO	No standard

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

RULE REQUIREMENTS:

Reg XI, Rule 1132 (Last amended 5/5/2006)
This rule applies to any spray booth facility, 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.

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:
1. An emission control system that has an overall efficiency of at least 65 percent by weight; or
2. 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
3. A combination of methods specified in paragraphs (c)(1) and (c)(2), which when individually applied do not meet the specified reduction

The requirements listed above shall not apply to the following:
1. A facility that has applied for and been issued by the Executive Officer an enforceable permit condition that limits the facility-wide VOC emissions from the use of VOC-containing materials to no more than 40,000 pounds (20 tons) per emission inventory year.

2. A spray booth that meets the following condition:

Exhaust Flow Rate (standard cubic feet per minute)	Allowable VOC Emissions (pounds per day)
Less than 10,000	12
10,000 or greater but less than 30,000	25
30,000 or greater but less than 60,000	50
60,000 or greater but less than 90,000	100
90,000 or greater but less than 275,000	150
275,000 or greater	225

3. A spray booth for which the VOC emissions are reduced through the use of an existing emission control system in operation under a valid District permit as of December 1, 2000, that is not mandatory pursuant to any other District requirement or the requirement of any other governmental agency. This exemption is only valid for facilities that are subject to the alternative compliance plan specified in paragraph (d)(2).

Since this BACT determination is for facilities ≤ 20 tons per year, this rule does not apply.

Reg XI, Rule 1136 (Last amended 6/14/1996)
A person or facility shall not apply coatings to wood 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 spray
B. Flow coat
C. Dip Coat
D. High-volume, low-pressure (HVLP) spray
E. Paint brush
F. Hand roller
G. Roll coater
H. Other coating application methods as are demonstrated to the Executive Officer to be capable of achieving at least 65 % transfer efficiency, and for which written approval of the Executive officer has been obtained

An operator shall not apply **any coating to a wood product** that exceeds the applicable limit specified below:

Coating Category (SCAQMD Rule 1136 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter, (lb/gal), [lbs-VOC/lbs-solid)]
Clear Sealers	275 (2.3) [0.36]
Clear topcoat	275 (2.3) [0.35]
Pigmented primers, sealers, & topcoats	275 (2.3) [0.21]
Pigmented topcoats	275 (2.3) [0.25]

Coating Category (SCAQMD Rule 1136 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter, (lb/gal), [lbs-VOC/lbs-solid)]
Barrier coat – plastic components	275 (2.3) [0.28]
Composite wood edge filler	275 (2.3) [0.31]
Extreme performance coatings	275 (2.3) [0.33]
Fillers	275 (2.3) [0.18]
High-solid stains	350 (2.9) [0.42]
Inks	500 (4.2) [0.96]
Mold-seal coatings	750 (6.3) [4.2]
Multi-colored coatings	275 (2.3) [0.33]

Coating Category (SCAQMD Rule 1136 Definition)	Maximum Allowable VOC Content grams/liter (lb/gal)
Low-solid barrier coat – plastic components	120 (1.00)
Low-solid Stains, Toners, and Washcoats	120 (1.00)

A person shall not use a stripper on wood products unless:
- It contains 350 grams of VOC per liter of material; or
- The VOC composite partial vapor pressure is 2 mm Hg (0.04 psia) or less at 20°C (68°F)

Reg XI, Rule 1171 (Last amended 5/1/2009)
This rule applies to all persons who use solvent materials in solvent cleaning operations during the production, repair, maintenance, or servicing of parts, products, tools, machinery, equipment, or general work areas; all persons who store and dispose of these materials used in solvent cleaning operations; and all solvent suppliers who supply, sell, or offer for sale solvent cleaning materials for use in solvent cleaning operations.

Solvent Cleaning Activity	VOC limits g/l (lb/gal)
(A) Product cleaning during manufacturing process or surface preparation for coating, adhesive, or ink application	
(i) General	25 (0.21)
(ii) Electrical apparatus components & electronic components	100 (0.83)
(iii) Medical Devices & pharmaceuticals	800 (6.7)

Solvent Cleaning Activity	VOC limits g/l (lb/gal)
(B) Repair and Maintenance Cleaning	
(i) General	25 (0.21)
(ii) Electrical apparatus components & electronic components	100 (0.83)
(iii) Medical Devices & pharmaceuticals	
(a) Tools, equipment, & machinery	800 (6.7)
(b) General work surfaces	600 (5.0)
(C) Cleaning of coatings or adhesives application equipment	25 (0.1)
(D) Cleaning of polyester resin application equipment	25 (0.21)

Reg XI, Rule 1147 – NOx Reductions from Miscellaneous Sources
(Last amended 7/7/2017)
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.

Equipment Category	NOx Emission Limit PPM @ 3% O2, dry or pound/MMBtu heat input		
	Process Temperature		
	≤ 800° F	> 800° F and < 1,200° F	≥ 1,200 ° F
Make-Up air heater or other air heater located outside of building with temperature controlled zone inside building	30 ppm or 0.036 lb/MMBtu	-	-

San Diego County APCD

BACT
Source: NSR Requirements for BACT, page 3-24. (June 2011)

Wood Products coating (< 10 gal/day)	
VOC	Use of water-based coatings when compatible with the operation and compliance with all other provisions of Rule 67.11, Wood Products Coating Operations for the rest of the operation
NOx	No standard
SOx	No standard
PM10	Spray booth equipped with overspray filters
PM2.5	Spray booth equipped with overspray filters
CO	No standard

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

RULE REQUIREMENTS:

Regulation 4, Rule 67.11 (Effective 6/27/13)
No coatings shall be applied unless one of the following coating application methods is used:
A. Hand application method
B. Dip coat
C. Roll coat
D. Flow coat
E. Electronic spray
F. High-volume low-pressure (HVLP) spray. Facilities using an HVLP spray gun shall have available on site pressure gauges in proper operating condition to measure the air cap pressure or have available manufacturer's technical information regarding the correlation between the handle air inlet pressure and the air cap pressure. If the correlation option is used to demonstrate compliance, a handle air inlet pressure gauge will be required on site in proper operating condition to measure the handle air inlet pressure; or
G. Other coating application methods that are demonstrated to have a transfer efficiency at least equal to one of the above application methods, and which are used in such a manner that the operating parameters under which they were demonstrated to achieve such transfer efficiency are permanent features of the method. Such coating application methods shall be approved in writing by the Air Pollution Control Officer prior to use.

A person shall not apply any coating to a **new wood product** 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 67.11 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lb/gal)
Clear Topcoats	275 (2.3)
Conversion Varnish	550 (4.6)
Filler	275 (2.3)
High-solid stain	350 (2.9)
Inks	500 (4.2)
Medium Density Fiberboard (MDF) Coatings	550 (4.6)
Multi-colored Coating	275 (2.3)
Pigmented Coating	275 (2.3)
Sealer	275 (2.3)
Any Other Coatings	275 (2.3)

Coating Category (SDCAPCD Rule 67.11 Definition)	Maximum Allowable VOC Content grams/liter (lb/gal)
Low-Solids coating, Toners, Washcoats	120 (1.00)

A person shall not apply any coating to a **refinished wood product** 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 67.11 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lb/gal)
Clear Topcoats	680 (5.7)
Conversion Varnish	550 (4.6)
Filler	500 (4.2)
High-solid stain	700 (5.8)
Inks	500 (4.2)
Medium Density Fiberboard (MDF) Coatings	680 (5.7)
Multi-colored Coating	680 (5.7)
Pigmented Coating	600 (5.0)
Sealer	680 (5.7)
Any Other Coatings	420 (3.5)

A person shall not apply low-solids coatings to a refinished wood product with a VOC content in excess of the following limits expressed as either grams of VOC per liter of material or pounds of VOC per gallon of material, as applied:

Coating Category (SDCAPCD Rule 67.11 Definition)	Maximum Allowable VOC Content grams/liter (lb/gal)
Low-solid barrier coat – plastic components	700 (5.8)
Low-solid Stains, Toners, and Washcoats	480 (4.0)

A person shall not use VOC containing materials for surface preparation unless the material contains 25 grams or less of VOC per liter of material

A person shall not use VOC containing materials for stripping unless:
- The material contains 200 grams or less of VOC per liter of material; or
- The material has a total VOC vapor pressure of 2 mm Hg or less, at 20°C (68°F)

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 161.8.1 (9/13/2000)

Spray Booth – Coating of Wood Products	
VOC	1. Coatings with VOC content less than that required by Reg. 8, Rule 32, and emissions controlled to overall capture/destruction efficiency ≥ 90% by weight (Technologically Feasible); or 2. Coatings with VOC content less than that required by Reg. 8, Rule 32 (Achieved in Practice)[(A)]
NOx	No standard
SOx	No standard
PM10	Dry filters or waterwash, properly maintained

Spray Booth – Coating of Wood Products	
PM2.5	No standard
CO	No standard

(A) Typical technology to meet this BACT is use of coatings with very low VOC contents (such as waterborne coatings, higher solids coatings, UV-cured coatings, polyester or polyurethane coatings, higher solids nitrocellulose lacquers, and solvent-substituted coatings).

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

RULE REQUIREMENTS:

Reg 8, Rule 32 (8/5/2009)
Any person who utilizes spray application equipment to apply coatings to wood products shall use one or more of the following application methods:
A. Airless spray
B. Air assisted airless spray
C. High Volume Low Pressure (HVLP) Spray
D. Electrostatic air spray
E. Detailing or Touch-up Guns
F. Other coating application methods demonstrated to the APCO to be capable of achieving at least 65% transfer efficiency as determined by the test method in 8-32-607, and for which written approval by the APCO has been obtained.

No person shall apply to any **general wood product**, any 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 gram of solids, as applied (after thinning), 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 Reg. 8 Rule 32 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter, (lb/gal), [g-VOC/g-solid)]
Clear Sealer	275 (2.3) [0.36]
Clear Topcoat	275 (2.3) [0.35]
Sanding Sealer	See clear or pigmented sealers
Pigmented Coating	See pigmented sealers or topcoats
Pigmented Primer, Sealer, And Undercoater	275 (2.3) [0.21]
Pigmented Topcoat	275 (2.3) [0.25]
High Solid Stain	350 (2.9) [0.42]
Filler	275 (2.3) [0.18]

Coating Category (BAAQMD Reg. 8 Rule 32 Definition)	Maximum Allowable VOC Content grams/liter (lb/gal)
Low-solid stain(A)	120 (1.0)
Low-solid Stains, Toners, and Washcoats	120 (1.0)

(A) Low-Solids Coatings VOC content is calculated including water and exempt compounds as set forth in Section 8-32-604. High-Solids Coatings VOC content is calculated excluding water and exempt compounds set forth in Section 8-32-605 and 8-32-606.

No person shall apply to any **wood furniture, custom cabinetry or custom architectural millwork**, any 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 gram of solids, as applied (after thinning), 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 Reg. 8 Rule 32 Definition)	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter, (lb/gal), [g-VOC/g-solid)]
Clear Sealer	275 (2.3) [0.36]
Clear Topcoat	275 (2.3) [0.35]
Single Application Conversion Varnish(A)	550 (4.6) [0.36]
Sanding Sealer	See clear or pigmented sealers
Pigmented Coating	See pigmented sealers or topcoats
Pigmented Primer, Sealer, And Undercoater	275 (2.3) [0.21]
Pigmented Topcoat	275 (2.3) [0.25]
High Solid Stain	350 (2.9) [0.42]
Filler	275 (2.3) [0.18]

(A) If more than one coating application is used, each sealer application must comply with the sealer VOC limits, and each topcoat application must comply with the topcoat VOC limits.

Coating Category (BAAQMD Reg. 8 Rule 32 Definition)	Maximum Allowable VOC Content grams/liter (lb/gal)
Low-solid stain(A)	120 (1.0)
Toner and Wash-coat(A)	120 (1.0)

(A) Low-Solids Coatings VOC content is calculated including water and exempt compounds as set forth in Section 8-32-604. High-Solids Coatings VOC content is calculated excluding water and exempt compounds set forth in Section 8-32-605 and 8-32-606.

No person shall apply to any **custom furniture**, any 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 gram of solids, as applied (after thinning), 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 Reg. 8 Rule 32 Definition)	**Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter, (lb/gal), [g-VOC/g-solid)]**
Clear Sealer	275 (2.3) [0.36]
Clear Topcoat	550 (4.6) [0.36]
Sanding Sealer	See clear or pigmented sealers
Pigmented Coating	See pigmented sealers or topcoats
Pigmented Primer, Sealer, And Undercoater	275 (2.3) [0.21]
Pigmented Topcoat	275 (2.3) [0.25]
Multi-colored Coating	275 (2.3) [0.33]
High Solid Stain	350 (2.9) [0.42]
Filler	275 (2.3) [0.18]

Coating Category (BAAQMD Reg. 8 Rule 32 Definition)	**Maximum Allowable VOC Content grams/liter (lb/gal)**
Low-solid stain(A)	120 (1.0)
Toner and Wash-coat(A)	120 (1.0)

(A) Low-Solids Coatings VOC content is calculated including water and exempt compounds as set forth in Section 8-32-604. High-Solids Coatings VOC content is calculated excluding water and exempt compounds set forth in Section 8-32-605 and 8-32-606.

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/or cleanup in connection with coating of wood products, and any person mixing, using or disposing of coating, adhesive or stripper containing organic solvent in connection with coating of wood products shall comply with the following requirements:

A. The person 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 store fresh or spent solvent in closed containers.
C. The person shall not use organic compounds for the cleanup of mixing or storage equipment unless for collecting the cleaning compounds and minimizing their evaporation to the atmosphere is used.
D. The person shall not use organic solvent for the cleanup of spray equipment, including coating lines, with VOC content in excess of 25 g/l (0.21 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.

E. The person shall not leave containers of stripper, coating, adhesive, catalyst, solvent or thinner open to the atmosphere when not in use.

No person shall use a solvent with a VOC content that exceeds 25g/l (0.21 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%.

San Joaquin Valley Unified APCD

BACT
Source: SJVAPCD BACT Guideline 4.4.1 (10/16/1996)

Wood Products Coating Operation – Non-continuous Batch Coating	
VOC	1. Utilizing HVLP or equivalent application equipment and using coatings compliant with District Rule 4606 (Achieved in practice); Or 2. Closed-face booth with thermal/catalytic incineration (Technologically feasible); Or 3. Closed-face booth with carbon adsorption (Technologically feasible)
NOx	No standard
SOx	No standard
PM10	Enclosed spray booth with exhaust filters and HVLP or equivalent application equipment
PM2.5	No standard
CO	No standard

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

RULE REQUIREMENTS:

Rule 4606 (Amended 10/16/2008)
An operator shall not apply coatings to wood 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. 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.
C. Hand roller

D. Flow coat
E. Roll coater
F. Dip coat
G. Paint brush
H. Detailing or touch-up guns; 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 6.6. Prior written approval from the APCO shall be obtained for each alternative method used.

An operator shall not apply **any coating to a wood product**, which has a VOC content, as applied, that exceeds the applicable limit specified below:

Coating Category (SJVAPCD Rule 4606 Definition)	**Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter (lb/gal)**
Clear Topcoats	275 (2.3)
Filler	275 (2.3)
High-Solids Stain	240 (2.0)
Ink	500 (4.2)
Mold-Seal Coating	750 (6.3)
Multi-Colored Coating	275 (2.3)
Pigmented Coating	275 (2.3)
Sanding Sealer	275 (2.3)

Coating Category (SJVAPCD Rule 4606 Definition)	**Maximum Allowable VOC Content grams/liter (lb/gal)**
Low-Solids Stain	120 (1.0)
Stripper	350 (2.9)

An operator shall not apply **any coating to flat wood paneling product**, which has a VOC content, as applied, that exceeds the applicable limit specified below:

Coating Category (SJVAPCD Rule 4606 Definition)	**Grams of VOC/liter (pounds of VOC/gallon) of coating, excluding water and exempt compounds, as applied**	**Grams of VOC/liter (pounds of VOC/gallon) of material, as applied**
Printed interior panels made of hardwood plywood, or thin particle board	250 (2.1)	350 (2.9)
Natural finish hardwood plywood panels		

Coating Category (SJVAPCD Rule 4606 Definition)	Grams of VOC/liter (pounds of VOC/gallon) of coating, excluding water and exempt compounds, as applied	Grams of VOC/liter (pounds of VOC/gallon) of material, as applied
Class II finishes on hardwood panels	250 (2.1)	350 (2.9)
Tileboard		
Exterior siding		

An operator shall not use a strippable booth coating with a VOC content in excess of 450 g/l (3.8 lb/gal) as applied, excluding water and exempt compounds.

An operator shall not use organic solvents for cleaning operations that exceed the content limits specified in the table below:

Type of Solvent Cleaning Operation	VOC Content Limit grams of VOC/liter of material (lb/gal)
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)

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

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
VOC	<u>For booths with < 4,219 lbs/year VOC Emissions</u> 1. 4,219 lb VOC/year limit, Compliance with SMAQMD Rule 463 and and BACT VOC limits and HVLP spray or eqivalent application equipment – [SMAQMD] 2. Compliance with SCAQMD Regulation XI, Rule 1136 – [SCAQMD] 3. Coatings with VOC content less than that required by Reg. 8, Rule 32(A) – [BAAQMD] 4. Compliance with SDCAPCD Rule 67.11 and use of water based coatings when compatible(B) – [SDCAPCD] 5. Utilizing High-volume low-pressure (HVLP) spray or equivalent application equipment, compliance with SJVAPCD Rule 4606(C) - [SJVAPCD] <u>For booths with ≥ 4,219 lbs/year VOC Emissions</u> 1. Compliance with SMAQMD Rule 463, SMAQMD BACT #191 VOC limits, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR – [SMAQMD] 2. Compliance with applicable AQMD Regulation XI Rules, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR – [SCAQMD] 3. Use of Super Clean Materials (< 5% VOC by weight); OR – [SMAQMD, SCAQMD] 4. Use of low-VOC materials resulting in an equivalent emission reduction – [SMAQMD, SCAQMD] <u>For spray booth facilities with > 40,000 lbs/year VOC Emissions</u> 1. An emission control system that has an overall efficiency of at least 65 percent by weight; OR – [SCAQMD] 2. VOC-containing materials that have a VOC content at least 65 percent lower than any applicable SCAQMD Reg XI Rule 1132 limit in effect as of January 19, 2001; OR – [SCAQMD] 3. A combination of methods specified in SCAQMD Reg XI Rule 1132 paragraphs (c)(1) and (c)(2), which when individually applied do not meet the specified reduction – [SCAQMD]
NOx	1. For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu [SMAQMD, SCAQMD Rule 1147] 2. No Standard – [SCAQMD, SDCAPCD, BAAQMD, SJVAPCD]
SOx	No Standard – [SMAQMD, SCAQMD, SDCAPCD, BAAQMD, SJVAPCD]
PM10	1. Enclosed spray booth with properly maintained dry filters or water wash; high transfer efficiency application equipment – [SMAQMD] 2. Enclosed spray booth with exhaust filters and HVLP or equivalent application equipment – [SJVAPCD] 3. Spray booth equipped with overspray filters [SDCAPCD] 4. Dry filters or waterwash, properly maintained – [SCAQMD, BAAQMD]
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash – [SMAQMD] 2. Spray booth equipped with overspray filters [SDCAPCD] 3. No Standard – [SCAQMD, BAAQMD, SJVAPCD]

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES	
CO	1. No Standard – [SMAQMD, SCAQMD, SDCAPCD, BAAQMD, SJVAPCD]
Organic HAP/VHAP (T-BACT)	<u>For booths with < 4,219 lbs/year VOC Emissions</u> 1. HVLP spray or equivalent application equipment, compliance with SMAQMD Rule 463, SMAQMD BACT #190 VOC limits. For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent. – [SMAQMD] 2. Meet emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63. – [US EPA] 3. Meet emission limits of Table 3 to Subpart JJ of Part 63. – [US EPA] <u>For booths with ≥ 4,219 lbs/year VOC Emissions</u> 1a. Compliance with SMAQMD Rule 463, SMAQMD BACT #191 VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringnet. With VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; 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. Meet emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63. – [US EPA] 3. Meet emission limits of Table 3 to Subpart JJ of Part 63. – [US EPA]

(A) Typical technology to meet this BACT is use of coatings with very low VOC contents (such as waterborne coatings, higher solids coatings, UV-cured coatings, polyester or polyurethane coatings, higher solids nitrocellulose lacquers, and solvent-substituted coatings).

(B) SDAPCD Rule 67.11 contains the most stringent VOC limit (200 g/l) for stripping materials. However, per conversations with SDAPCD, facilities in their county have been complying with this rule by meeting the alternate stripping requirement of the stripping material having a total VOC vapor pressure of 2 mm Hg or less, at 20°C (68°F). Therefore the 200 g/l won't be considered achieved in practice.

(C) SJVAPCD Rule 4606 contains the most stringent VOC limit (240 g/l) for high-solid stains. However, per BAAQMD's Wood Products Coatings Workshop Report (4/09), CARB and every coating manufacturer has indicated there are on-going implementation issues with high-solid stains meeting the 240 g/l VOC limit. Therefore this limit won't be considered achieved in practice.

T-BACT limits of the NESHAP Subparts QQQQ and JJ are not technologically feasible for small sources. These NESHAPs apply to only to large facilities in very specific source categories. Therefore, T-BACT will only apply the NESHAP standards of Subparts QQQQ and JJ to major sources of HAPs.

SMAQMD has found that coating processes exempted in SMAQMD's Rule 463 can't be achieved in practice using the previously determined BACT VOC limits that combined other air district rule VOC limits. The combined BACT VOC limits also did not take into account the exemptions listed in the respective air district rules. Therefore, SMAQMD's BACT will be updated to include compliance with Rule 463 which will allow the use of exemptions to apply to BACT limits.

This BACT Determination will exclude facilities with emissions < 40,000 lbs/year (20 tons/year) so standards from SCAQMD's Reg XI Rule 1132 will not apply.

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 with VOC Emissions ≤ 4,219 lb VOC/year</u> 1. Compliance with SMAQMD Rule 463[(A)] and SMAQMD BACT #190 VOC limits and HVLP spray or equivalent application equipment <u>For booths with VOC Emissions or > 4,219 lb VOC/year[(B)]</u> 1. Compliance with SMAQMD Rule 463[(A)], SMAQMD BACT #191 VOC limits, and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR 2. Use of Super Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction	SMAQMD
NOx	1. For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu	SMAQMD, SCAQMD
SOx	No standard	SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDCAPCD
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment	SMAQMD, SJVAPCD, SCAQMD, BAAQMD
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash.	SMAQMD, SCAQMD, BAAQMD, SDCAPCD
CO	No Standard	SMAQMD, SCAQMD, BAAQMD, SJVAPCD, SDCAPCD

BEST CONTROL TECHNOLOGIES ACHIEVED		
Pollutant	**Standard**	**Source**
Organic HAP/VHAP (T-BACT)	<u>For booths without add-on control equipment</u> 1. HVLP spray or equivalent application equipment 2. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT #190 VOC limits. For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent. <u>For booths with add-on control equipment</u> 1. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT #191 VOC limits. For major sources emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent. With VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR 2. Use of Super Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction.	SMAQMD, NESHAP 40 CFR 63 Subpart QQQQ, NESHAP 40 CFR 63 Subpart JJ SMAQMD, NESHAP 40 CFR 63 Subpart QQQQ, NESHAP 40 CFR 63 Subpart JJ

(A) Compliance with SMAQMD Rule 463 includes 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.
(B) The cost effective threshold of 4,219 lb VOC/year is based on outdated cost data. The updated cost effective threshold is revised in Section B of this BACT Determination.

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 Alternatives
VOC	1. Carbon Adsorber 2. 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 Effectiveness 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	17,500
NO_X	24,500
PM10	11,400
SO_X	18,300
CO	TBD if BACT triggered

Cost Effectiveness Analysis Summary

A previous cost effectiveness analysis determined that 4,219 lb VOC/year was the highest allowable uncontrolled emission rate that did not require any add-on control devices. The EPA has updated the cost manual for incinerators/oxidizers in 11/2017 and carbon adsorbers in 10/2018. Therefore, this BACT determination will revisit this limit in accordance with the updated EPA OAQPS Air Pollution Control Cost Manual. The electricity (13.80 cents/kWh) and natural gas (8.04 dollars/1,000 cubic feet) rates were based on a commercial 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.

1. **Carbon Adsorber:**

   As shown in Attachment D, the cost effectiveness for the add on carbon adsorber system to control VOC was calculated to be **$17,509.23/ton** (see attached Paint Spray Booth for Automotive Coating Cost Effectiveness Analysis). The following basic parameters were used in the analysis.

   Equipment Life = 15 years

   Total Capital Investment = $307,618

   Direct Annual Cost = $13,549 per year

   Indirect Annual Cost = $46,994 per year

   Total Annual Cost = $58,344 per year

   VOC Removed = 3 tons per year

   Cost of VOC Removal = $17,509.23 per ton reduced

A detailed calculation of the cost effectiveness for VOC removal with a carbon absorber is shown in Attachment D. Uncontrolled VOC emissions of 7,404 lb/year or greater is the cost-effective threshold for control equipment using carbon absorption control technology

2. Thermal Oxidizer:

Equipment Life = 20 years

Total Capital Investment = $1,120,882

Direct Cost = $193,478

Direct Annual Cost = $73,514 per year

Indirect Annual Cost = $134,493 per year

Total Annual Cost = $208,007 per year

VOC Removed = 12.1 tons per year

Cost of VOC Removal = $17,657 per ton reduced

A detailed calculation of the cost effectiveness for VOC removal with a thermal oxidizer is shown in Attachment D. Uncontrolled VOC emissions of 23,799 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 7,404 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 23,799 lb per year or greater must be reached in order for a thermal oxidizer to be cost effective. The emissions levels for the cost effectiveness of controls is based on the District cost effective limit for VOC of $17,500 per ton controlled.

With EPA's new cost data, the highest allowable uncontrolled emission rate to not require add-on control devices will be updated to 7,404 lb/year based on the cost of carbon adsorption.

C. SELECTION OF BACT/T-BACT:

Based on the review of SMAQMD, SCAQMD, SDCAPCD, BAAQMD, SJVAPCD, ARB, and EPA BACT Clearinghouses and cost effectiveness determinations, BACT for VOC, PM10, and PM2.5 will be the following:

BACT #277 for Paint Spray Booths for Wood Coatings Emissions ≤ 7,404 lbs VOC/year and Facility Emissions ≤ 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
VOC	1. HVLP spray or equivalent application equipment 2. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below)	SMAQMD, SJVAPCD, SCAQMD, SDCAPCD, BAAQMD ,
NOx	1. For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu	SCAQMD
SOx	No standard	
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment	SJVAPCD, SCAQMD,BAAQMD
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash.	SDCAPCD, SCAQMD, BAAQMD,
CO	No Standard	

(A) Compliance with SMAQMD Rule 463 includes 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 #277 for Paint Spray Booths for Wood Coatings Emissions ≤ 7,404 lbs VOC/year and Facility Emissions ≤ 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
Organic HAP/VHAP (T-BACT)	1. HVLP spray or equivalent application equipment 2. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63, whichever is more stringent.	SCAQMD, NESHAP 40 CFR 63 Subpart QQQQ, NESHAP 40 CFR 63 Subpart JJ

(A) Compliance with SMAQMD Rule 463 includes 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.

BACT #278 for Paint Spray Booths for Wood Coatings Emissions > 7,404 lb VOC/year and Facility Emissions ≤ 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
VOC	1. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, 7solvent cleaning, and stripping VOC limits (see Tables 1-3 below) and VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR 2. Use of Super Clean Materials (< 5% VOC by weight); OR 3. Use of low-VOC materials resulting in an equivalent emission reduction	SCAQMD
NOx	1. For heaters, low NOx burner, 30 ppmvd @ 3% O2 or 0.036 lb/MMBtu	SCAQMD
SOx	No standard	
PM10	1. Enclosed spray booth with properly maintained dry filters or waterwash. 2. HVLP spray or equivalent application equipment	SJVAPCD SCAQMD BAAQMD
PM2.5	1. Enclosed spray booth with properly maintained dry filters or waterwash.	SDCAPCD SCAQMD BAAQMD
CO	No Standard	

(A) Compliance with SMAQMD Rule 463 includes 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 #278 for Paint Spray Booths for Wood Coatings Emissions > 7,404 lb VOC/year and Facility Emissions ≤ 40,000 lbs VOC/year		
Pollutant	**Standard**	**Source**
Organic HAP/VHAP (T-BACT)	1. Compliance with SMAQMD Rule 463(A) and SMAQMD BACT coating, solvent cleaning, and stripping VOC limits (see Tables 1-3 below). For major sources, emission limits of Tables 1 & 2 to Subpart QQQQ of Part 63 and emission limits of Table 3 to Subpart JJ of Part 63. 2. VOC control system with ≥ 90% collection efficiency and ≥ 95% destruction efficiency; OR 3. Use of Super Clean Materials (< 5% VOC by weight); OR 4. Use of low-VOC materials resulting in an equivalent emission reduction	SCAQMD, NESHAP 40 CFR 63 Subpart QQQQ, NESHAP 40 CFR 63 Subpart JJ

(A) Compliance with SMAQMD Rule 463 includes 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.

An operator shall not apply **any coating to a wood product** that exceeds the applicable limit specified below:

Table 1: BACT Wood Coating VOC Limits(A)

Coating Category	Maximum Allowable VOC Content Excluding Water and Exempt Compounds grams/liter, (lb/gal), [lbs-VOC/lbs-solid)]
Clear Sealers	275 (2.3) [0.36]
Clear topcoat	275 (2.3) [0.35]
Pigmented primers, sealers, & topcoats	275 (2.3) [0.21]
Pigmented topcoats	275 (2.3) [0.25]
Barrier coat – plastic components	275 (2.3) [0.28]
Composite wood edge filler	275 (2.3) [0.31]
Extreme performance coatings	275 (2.3) [0.33]
Fillers	275 (2.3) [0.18]
High-solid stains	350 (2.9) [0.42]
Inks	500 (4.2) [0.96]
Mold-seal coatings	750 (6.3) [4.2]
Multi-colored coatings	275 (2.3) [0.33]

(A) VOC limits are based on SCAQMD Regulation XI, Rule 1136.

Table 1: BACT Wood Coating VOC Limits (continued)(A)

Coating Category	Maximum Allowable VOC Content grams/liter (lb/gal)
Low-solid barrier coat – plastic components	120 (1.00)
Low-solid Stains, Toners, and Washcoats	120 (1.00)

(A) VOC limits are based on SCAQMD Regulation XI, Rule 1136.

An operator shall not use organic solvents for cleaning operations that exceed the content limits specified in the table below:

Table 2: BACT Solvent Cleaning VOC Limits(A)

Type of Solvent Cleaning Operation	VOC Content Limit grams of VOC/liter of material (lb/gal)
Product cleaning during manufacturing process or surface preparation for coating, adhesive, or ink application	25 (0.21)
Repair and maintenance cleaning	25 (0.21)
Cleaning of adhesive and coating application equipment	25 (0.21)
Cleaning of polyester resin application equipment	25 (0.21)

(A) VOC limits are based on SCAQMD Regulation XI, Rule 1171.

A person shall not use VOC containing materials for stripping unless the material meets one of the following requirements:

Table 3: BACT Stripper VOC Limits(A)

Stripper Requirements	
VOC Limit	≤ 350 grams VOC/liter; OR
VOC vapor pressure limit	Total vapor pressure of 2 mm HG or less, at 20°C (68°F)

(A) VOC limits are based on SCAQMD Regulation XI, Rule 1136.

APPROVED BY: *Brian F Krebs* **DATE:** 11-19-2021

Attachment A

Review of BACT Determinations published by EPA

List of BACT determinations published in EPA's RACT/BACT/LAER Clearinghouse (RBLC) for Wood Products/Furniture Surface Coating:

RBLC	Permit Date	Process Code [A]	Process/Equipment	Pollutant	Standard	Control Technology	Case-By-Case Basis
AL-0229	5/18/2007	41.025	Two Overhead Coating Lines	VOC	N/A	Coating Reformulation	BACT-PSD
AL-0224	4/18/2006	41.025	Glaze Booth, Toner Booth, Seater Booths, Natural Gas-fired Oven	VOC	N/A	Coating Reformulation	BACT-PSD
OR-0045	8/04/2005	41.025	Cabinet Finishing	VOC	N/A	California VOC Content limits were used as the basis for this BACT-PSD Determination	BACT-PSD
PA-0263	3/27/2006	41.025	Overhead line	VOC	N/A	Paint Filter	Other Case-By-Case
PA-0269	2/23/2006	41.025	Laboratory Spray Booth	VOC	N/A	No Controls Feasible	Other Case-By-Case
VA-0295	9/23/2011	41.025	Wood Finishing	VOC	N/A	Good Work Practices	MACT
				FPM10[D]	N/A	Dry Overspray Filters	MACT
VA-0300	4/26/2011	41.025	Spray Booths for Cabinets	VOC	N/A	Proper spraying techniques and the use of high solids coating whenever possible	BACT-PSD
				PM	N/A	Dry filters, proper spray techniques, and work practice standards of 40 CFR Subpart JJ. Each filter shall be equipped with a device to continuously measure the differential pressure drop across the filter.	BACT-PSD
				FPM10[D]	N/A		BACT-PSD

RBLC	Permit Date	Process Code (A)	Process/Equipment	Pollutant	Standard	Control Technology	Case-By-Case Basis
VT-0030	4/26/2011	41.025	Roll Coating Lines	VOC	N/A	Limiting the VOC content of the stains and coatings.	BACT-PSD

(A) Process Code 41.025 includes wood products/furniture surface coatings.
(B) Filterable particulate matter less than 10 micrometers.

= Determination is not for a spray paint booth.

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

Attachment B

BACT Determinations from Air Districts

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
Best Available Control Technology (BACT) Guidelines for Non-Major Polluting Facilities*

10-20-2000 Rev. 0
2-1-2019 Rev 1

Equipment or Process: Spray Booth

	Criteria Pollutants					
Subcategory/ Rating/Size	**VOC**	**NOx**	**SOx**	**CO**	**PM_{10}**	**Inorganic**
Automotive, Down-Draft Type, < 667 Lbs/Month of VOC Emissions (2-1-2019)	Compliance with Applicable SCAQMD Regulation XI Rules (10-20-2000)				Dry Filters or Waterwash (1990)	
Other Types, < 1170 Lbs/Month of VOC Emissions	Compliance with Applicable SCAQMD Regulation XI Rules (10-20-2000)				Same as Above (1990)	
Automotive, Down-Draft Type, ≥ 22 Lbs/Day of VOC Emissions	- Compliance with Applicable SCAQMD Regulation XI Rules, and VOC Control System with ≥ 90% Collection Efficiency and ≥ 95% Destruction Efficiency, or - Use of Super Compliant Materials (< 5% VOC by weight): or - Use of Low-VOC Materials Resulting in an Equivalent Emission Reduction (10-20-2000)				Same as Above (1990)	
Other Types, ≥ 1170 Lbs/Month of VOC Emissions	Same as Above (10-20-2000)				Same as Above (1990)	

Note: The sum of all VOC emissions from all spray booths within the same subcategory applied for in the previous two years at the same facility are considered toward the emission threshold.

* Means those facilities that are not major polluting facilities as defined by Rule 1302 - Definitions

WOOD PRODUCTS COATING (<10 gal/day)
Fee Schedules 27L, 27M and 27Q[1]

Review the BACT Control Option listed below. The applicant must propose the Control Option listed or perform a Top-down BACT Analysis as described in Section 4 to justify the selection of another Control Option. The applicant will be required to provide documentation that the Control Option selected meets the requirements listed in the table.

	VOC	NOx	SOx	PM
BACT Emission Rate Limit	Not Determined	(N/A)	(N/A)	Not Determined
BACT Control Option (A/P)	Use of water-based coatings when compatible with the operation and compliance with all other provisions of Rule 67.11, Wood Products Coating Operations for the rest of the operation. (A/P)	(N/A)	(N/A)	Spray booth equipped with overspray filters. (A/P)

The applicant may choose to limit the Potential to Emit (PTE) from the equipment to less than 10 pounds per day for each pollutant in lieu of meeting the stated BACT requirement.

(This table does not apply to operations applying, on average, 10 or more gallons of coating per day.)

[1] 27L (Sources/facilities <5 tons per year VOC emissions), 27M (Sources/facilities >5 tons per year VOC emissions), and 27Q (≤500 gallons per year)

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
Best Available Control Technology (BACT) Guideline

Source Category

Source:	*Spray Booth - Coating of Wood Products*	Revision:	*2*
		Document #:	*161.8.1*
Class:	*All*	Date:	*09/13/00*

Determination

POLLUTANT	BACT 1. Technologically Feasible/ Cost Effective 2. Achieved in Practice	TYPICAL TECHNOLOGY
POC	1. *Coatings w/ VOC content less than that required by Reg. 8, Rule 32, and emissions controlled to overall capture/ destruction efficiency ≥ 90% by weight* [a,b] 2. *Coatings w/ VOC content less than that required by Reg. 8, Rule 32* [a,b]	1. *Collection System Vented to Carbon Adsorber or Afterburner* [a,b] 2. *Use of coatings with very low VOC contents (such as waterborne coatings, higher solids coatings, uv-cured coatings, polyester or polyurethane coatings, higher solids nitrocelluose lacquers, and solvent-substituted coatings)* [a,b]
NOx	1. *n/a* 2. *n/a*	1. *n/a* 2. *n/a*
SO_2	1. *n/a* 2. *n/a*	1. *n/a* 2. *n/a*
CO	1. *n/a* 2. *n/a*	1. *n/a* 2. *n/a*
PM_{10}	1. *n/d* 2. *n/s*	1. *n/d* 2. *Dry Filters or Waterwash, Properly Maintained*[a]
NPOC	1. *Coatings w/ solvent content less than that required by Reg. 8, Rule 32, and emissions controlled to overall capture/ destruction efficiency ≥90%* [a,b] 2. *Coatings w/ VOC content less than that required by Reg. 8, Rule 32* [a,b]	1. *Collection System Vented to Carbon Adsorber* [a,b] 2. *Use of coatings with very low VOC contents* [a,b]

SJVAPCD BACT

Best Available Control Technology (BACT) Guideline 4.4.1
Last Update: 10/16/1996

Wood Products Coating Operation - Non-Continuous Batch Coating

Pollutant	Achieved in Practice or in the SIP	Technologically Feasible	Alternate Basic Equipment
PM10	Enclosed spray booth with exhaust filters and HVLP or equivalent application equipment		
VOC	Utilizing HVLP or equivalent application equipment and using coatings compliant with District Rule 4606	1. 100% capture efficiency (closed-face booth) with thermal/catalytic incineration, and using coatings with a VOC content (less water and exempt compounds) of 4.6 lb/gal for clear topcoats, 5.0 lb/gal for high-solids coatings, 4.6 lb/gal for sanding sealers, 2.2 lb/gal for water based pigmented primers and 2.4 lb/gal for water based pigmented topcoats 2. 100% capture efficiency (closed-face booth) with carbon adsorption, and using coatings with a VOC content (less water and exempt compounds) of 4.6 lb/gal for clear topcoats, 5.0 lb/gal for high-solids coatings, 4.6 lb/gal for sanding sealers, 2.2 lb/gal for water based pigmented primers and 2.4 lb/gal for water based pigmented topcoats 3. Utilizing HVLP or equivalent application equipment and coatings with a VOC content (less water and exempt compounds) of 4.6 lb/gal for clear topcoats, 3.2 lb/gal for high-solids coatings, 4.6 lb/gal for sanding sealers, 0.68 lb/gal for water based pigmented primers, and 1.62 lb/gal for water based pigmented topcoats	

Attachment C

Cost Effectiveness Determination for Carbon Adsorption and Thermal Oxidizers

COST EFFECTIVENESS ANALYSIS FOR CARBON ADSORPTION

Data Inputs

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

RESET

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°F)	
VOC Emission Rate (m_{voc})	3.560	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	2020			
CEPCI* for 2020	567.5	CEPCI value for 2020	390.6	1999
Annual Interest Rate (i)	4	percent (Current bank prime rate)		

* CEPCI is the Chemical Engineering Plant Cost Index. The use of CEPCI in this spreadsheet is not an endorsement of the index for purpose of cost escalation or de-escalation, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Electricity (P_{elec})	$0.1380	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 known, use 1.10 x operator labor rate.
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 known.
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 actual value of
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 enter actual value,

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.

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 2020 dollars)

Parameter	Equation	Cost
Costs for Each Carbon Adsorber Vessel (C_v) =	$271 \times F_m \times S^{0.778}$ =	$25,175
Total Cost for All Carbon Adsorber Vessels and Carbon(EC_{Adsorb}) =	$5.82 \times Q^{-0.133} \times [C_c + (N_A + N_D) \times C_v]$ =	$131,885
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) =	= $EC_{Adsorb} + EC_{aux}$ =	$163,885
Instrumentation =	0.10 × A =	Included in A
Sales taxes =	0.03 × A =	$4,917
Freight =	0.05 × A =	$8,194
	Total Purchased Equipment Costs (B) =	$176,995

Direct Installation Costs (in 2020 dollars)

Parameter	Equation	Cost
Foundations and Supports =	0.08 × B =	$14,160
Handling and Erection =	0.14 × B =	$24,779
Electrical =	0.04 × B =	$7,080
Piping =	0.02 × B =	$3,540
Insulation =	0.01 × B =	$1,770
Painting =	0.01 × B =	$1,770
Site Preparation (SP) =		$0
Buildings (Bldg) =		$0
	Total Direct Costs (DC) = B + (0.3 × B) + SP + Bldg =	$230,094

Total Indirect Installation Costs (in 2020 dollars)			
Parameter	**Equation**		**Cost**
Engineering =	0.10 × B =		$17,700
Construction and field expenses =	0.05 × B =		$8,850
Contractor fees =	0.10 × B =		$17,700
Start-up =	0.02 × B =		$3,540
Performance test =	0.01 × B =		$1,770
		Total Indirect Costs (IC) =	$49,559
Contingency Cost (C) =	CF(IC+DC)=		$27,965
Total Capital Investment (TCI) =	**DC + IC + C = (1.28 × B) + SP + Bldg. + C =**		**$307,618** **in 2020 dollars**

Annual Costs

Direct Annual Costs		
Parameter	**Equation**	**Cost**
Annual Electricity Cost =	$Q_{Elec} \times P_{elec}$ =	$738
Annual Steam Cost (C_s) =	3.50 x m_{voc} x Θ_s x P_s =	$130
Annual Cooling Water Cost (C_{cs}) =	3.43 x C_s/P_s x P_{wc} =	$316
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 =	$7
	Carbon = CRF_{carbon} x CC x M_c x 1.08 =	$392
Direct Annual Costs (DAC) =		**$13,549** **in 2020 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	$6,152	
Property Taxes	= 1% of TCI	$3,076	
Insurance	= 1% of TCI	$3,076	
Capital Recovery	= $CRF_{Adsorber}$ × (TCI - [(1.08 x CC x M_c) + (LR x M_c/CRR)] =	$27,508	
Indirect Annual Costs (IAC) =		**$46,994**	**in 2020 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)	$= m_{voc} \times \Theta_s \times P_{voc} \times E =$	$2,199
Total Annual Cost (TAC) =	**DAC + IAC + C + $Disposal_{Cost}$ - RC =**	**$58,344**	**in 2020 dollars**

Cost Effectiveness

Cost Effectiveness

Parameter	Equation	Cost	
Total Annual Cost =	TAC =	$58,344	per year in 2020 dollars
Annual Quantity of VOC Removed/Recovered =	$W_{voc} = m_{voc} \times \Theta_s \times E =$	3	tons/year
Cost Effectiveness =	Total Annual Cost (TAC) / Annual Quantity of VOC Removed/Recovered =	$17,509.23	per ton of pollutants removed/recovered in 2020 dollars

COST EFFECTIVENESS ANALYSIS FOR THERMAL INCINERATION

Data Inputs

Select the type of oxidizer: Regenerative Thermal Oxidizer

RESET

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	40	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)	99	percent*	* 99 percent is a default control efficiency. User should enter actual value, if known.
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	2020			
CEPCI* for 2020	541.7	Enter the CEPCI value for 2020	541.7	2016 CEPCI
Annual Interest Rate (i)	4	Percent		
Electricity ($Cost_{elect}$)	0.138	$/kWh		
Natural Gas Fuel Cost ($Cost_{fuel}$)	0.00804	$/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.

* CEPCI is the Chemical Engineering Plant Cost Escalation/De-escalation Index. The use of CEPCI in this spreadsheet is not an endorsement of the index for purposes of cost escalation or de-escalation, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., M&S) is acceptable.

Cost Estimate

Direct Costs			
Total Purchased equipment costs (in 2020 dollars)			
Incinerator + auxiliary equipment[a] (A) =			
Equipment Costs (EC) for Regenerative Oxidizer	=[2.664 x 100,000 + (13.98 x Qtot)] x (2020 CEPI/2016 CEPCI) =	$546,548	in 2020 dollars
Instrumentation[b] =	0.10 × A =	$54,655	
Sales taxes =	0.03 × A =	$16,396	
Freight =	0.05 × A =	$27,327	
	Total Purchased equipment costs (B) =	$644,926	in 2020 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 2020 dollars)			
Foundations and Supports =	0.08 × B =	$51,594	
Handlong and Errection =	0.14 × B =	$90,290	
Electrical =	0.04 × B =	$25,797	
Piping =	0.02 × B =	$12,899	
Insulation for Ductwork =	0.01 × B =	$6,449	
Painting =	0.01 × B =	$6,449	
Site Preparation (SP) =		$0	
Buildings (Bldg) =		$0	
	Total Direct Installaton Costs =	$193,478	
Total Direct Costs (DC) =	Total Purchase Equipment Costs (B) + Total Direct Installation Costs =	$838,404	in 2020 dollars
Total Indirect Installation Costs (in 2020 dollars)			
Engineering =	0.10 × B =	$64,493	
Construction and field expenses =	0.05 × B =	$32,246	
Contractor fees =	0.10 × B =	$64,493	
Start-up =	0.02 × B =	$12,899	
Performance test =	0.01 × B =	$6,449	
	Total Indirect Costs (IC) =	$180,579	
Continency Cost (C) =	CF(IC+DC)=	$101,898	
Total Capital Investment =	**DC + IC +C =**	**$1,120,882**	**in 2020 dollars**

Direct Annual Costs		
Annual Electricity Cost	= Fan Power Consumption × Operating Hours/year × Electricity Price =	$22,227
Annual Fuel Costs for Natural Gas	= $Cost_{fuel}$ × Fuel Usage Rate × 60 min/hr × Operating hours/year	$39,319
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) =		**$73,514 in 2020 dollars**

Indirect Annual Costs		
Overhead	= 60% of sum of operating, supervisor, maintenance labor and maintenance materials	$7,181
Administrative Charges	= 2% of TCI	$22,418
Property Taxes	= 1% of TCI	$11,209
Insurance	= 1% of TCI	$11,209
Capital Recovery	= CRF[TCI-1.08(cat. Cost)]	$82,476
Indirect Annual Costs (IC) =		**$134,493 in 2020 dollars**

Total Annual Cost =	**DC + IC =**	**$208,007 in 2020 dollars**

Cost Effectiveness

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

Total Annual Cost (TAC) =	$208,007	per year in 2020 dollars
VOC/HAP Pollutants Destroyed =	11.8	tons/year
Cost Effectiveness =	$17,657	per ton of pollutants removed in 2020 dollars