10.6.1 Waferboard/Oriented Strandboard Manufacturing

10.6.1.1 General[1,2] -

Waferboard (WB) and oriented strandboard (OSB) belong to the subset of reconstituted wood panel products called flakeboards. They are structural panels made from wood wafers specially produced from logs at the plant. When waferboard was developed in the 1950s, the wafers were not intentionally oriented. However, by 1989 most waferboard plants were producing oriented waferboard (OWB). Oriented strandboard originated in the early 1980s. The relatively long and narrow flakes (strands) are blended with resin and formed into a 3- or 5-layered mat. Aligning the strands in each layer perpendicular to adjacent layers gives OSB flexural properties superior to those of randomly oriented waferboard. Oriented waferboard and OSB are suitable for the same markets and uses as softwood plywood including sheathing, single-layer flooring, and underlayment in light-frame construction.

Oriented strandboard is produced from either hardwoods or softwoods. Softwoods generally correspond to coniferous species. The most commonly used softwoods for manufacturing OSB are pines, firs, and spruce. Hardwoods generally correspond to deciduous species. Aspen is the most commonly used hardwood species for manufacturing OSB.

10.6.1.2 Process Description[1,2] -

Figure 10.6.1-1 presents a typical process flow diagram for a WB/OSB plant. WB/OSB manufacturing begins with whole logs, which are debarked and may be cut to 2.5-m (8-ft.) lengths, called bolts, by a slasher saw in preparation for the waferizer. Some mills do not slash debarked logs into bolts, but instead feed whole debarked logs into the waferizer. In northern plants, these logs are put in hot ponds maintained at a temperature between 18° and 43°C (80° and 120°F). This pretreatment prepares the logs for the waferizer by thawing them during winter operations. The waferizer slices the logs into wafers approximately 3.8 cm (1.5 in.) wide by 7.6 to 15 cm (3 to 6 in.) long by 0.07 cm (0.028 in.) thick. The wafers may pass through green screens to remove fines and differentiate core and surface material, or they may be conveyed directly to wet wafer storage bins to await processing through the dryers.

Triple-pass rotary drum dryers are typical in WB/OSB plants. The rotary dryers are normally fired with wood residue from the plant, but occasionally oil or natural gas also are used as fuels. Rotary dryers operate with dryer inlet temperatures of around 540°C (1,000°F) and ranging as high as 870°C (1,600°F). Conveyor dryers may also be used to dry wafers. Conveyor dryers are typically indirectly heated and operate with dryer inlet temperatures of around 160°C (320°F). Regardless of dryer type, wafers are dried to a low moisture content (generally 4 to 10 percent, dry basis) to compensate for moisture gained by adding resins and other additives. Generally, dryers are dedicated to drying either core or surface material to allow independent adjustment of moisture content. This independent adjustment is particularly important where different resins are used in core and surface materials.

After drying, the dried wafers are conveyed pneumatically from the rotary dryer, separated from the gas stream at the primary cyclone, and screened to remove fines (which absorb too much resin) and to separate the wafers by surface area and weight. The gas stream continues through an air pollution control device and is emitted to the atmosphere. Undersized material is sent to a storage area for use as fuel for dryer burners or boilers. The screened wafers are stored in dry bins.

The dried wafers then are conveyed to the blender, where they are blended with resin, wax, and other additives. The most commonly used binders are thermosetting phenol-formaldehyde and isocyanate resins. From the blender, the resinated wafers are conveyed to the former, where they are metered out on a continuously moving screen system. The mat forming process is the only step in the manufacturing process in which there is any significant difference between WB and OSB production. In

WB production, the wafers are allowed to fall randomly to the moving screen below to form a mat of the required thickness. In OSB production, the wafers are mechanically oriented in one direction as they fall to the screen below. Subsequent forming heads form distinct layers in which the wafers are oriented perpendicular to those in the previous layer. The alternating oriented layers result in a structurally superior panel.

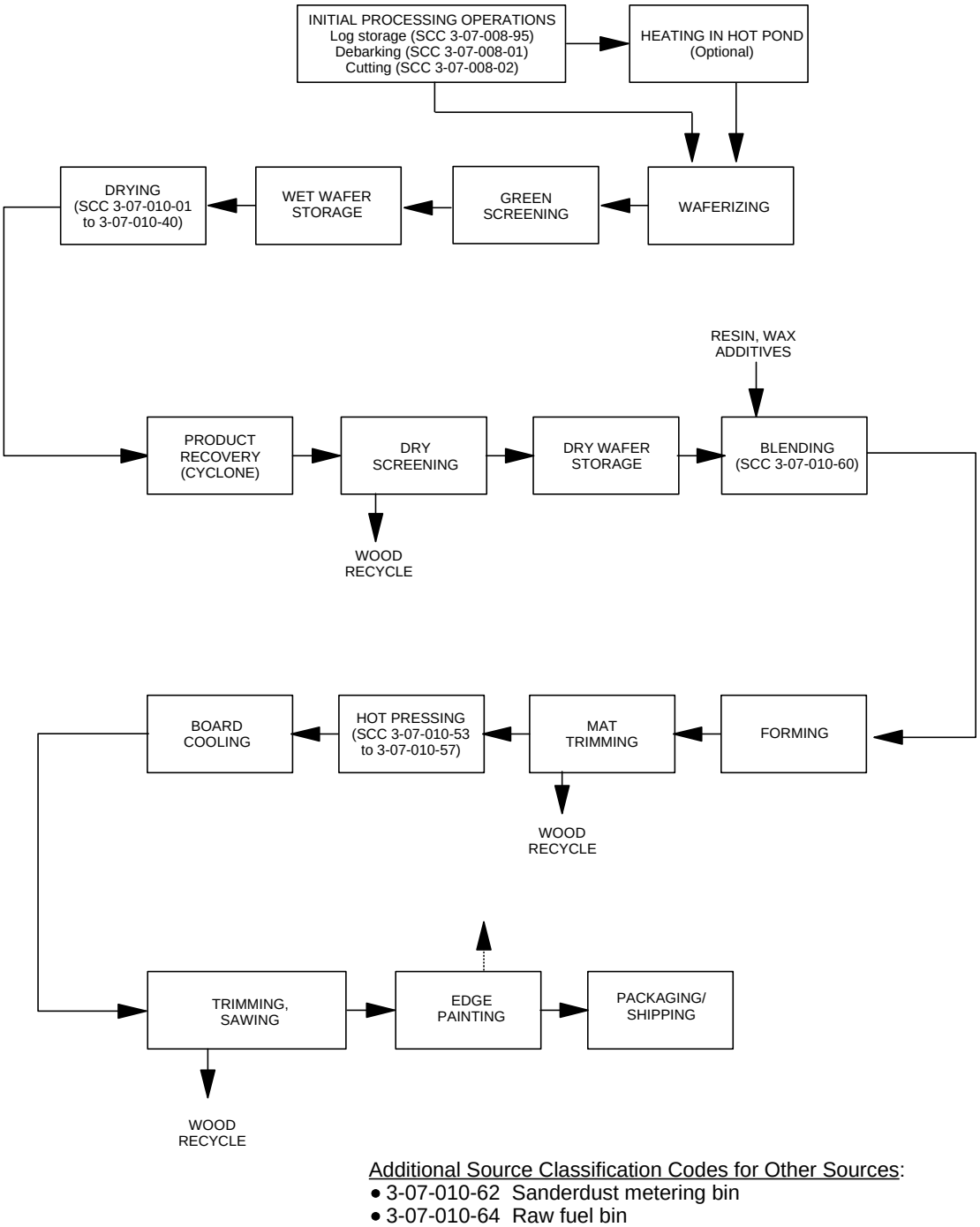

Figure 10.6.1-1. Typical process flow diagram for a waferboard/oriented strandboard plant.

In the mat trimming section, the continuous formed mat is cut into desired lengths by a traveling saw. The trimmed mat then is passed to the accumulating press loader and sent to the multi-opening, batch hot press. Continuous presses are also used. The press applies heat and pressure to activate the resin and bond the wafers into a solid reconstituted product. In most hot presses, heat is provided by steam generated by a boiler that burns plant residuals. Hot oil and hot water also can be used to heat the press. Boards exiting the press are usually hot stacked. Although uncommon, some plants may cool boards prior to stacking. After cooling, the bonded panels are trimmed to final dimensions, finished as necessary, and packaged for shipment.

10.6.1.3 Emissions And Controls[1-59] -

The primary emission sources at WB/OSB mills are wafer dryers and hot press vents. Other emission sources may include boilers, log debarking, sawing, waferizing, blending, forming, board cooling, and finishing operations such as sanding, trimming, and edge painting. Other potential emissions sources ancillary to the manufacturing process may include wood chip storage piles and bins (including wood fuel), chip handling systems, and resin storage and handling systems.

Operations such as log debarking, sawing, and waferizing, in addition to chip piles and bins, and chip handling systems generate particulate matter (PM) and PM less than 10 micrometers in aerodynamic diameter (PM-10) emissions in the form of sawdust and wood particles. In addition, these processes may be sources of PM less than 2.5 micrometers in aerodynamic diameter (PM-2.5) emissions.

Emissions from dryers that are exhausted from the primary recovery cyclone include wood dust and other solid PM, volatile organic compounds (VOCs), condensible PM, and products of combustion such as carbon monoxide (CO), carbon dioxide (CO_2), and nitrogen oxides (NO_x), if direct-fired units are used. The condensible PM and a portion of the VOCs leave the dryer stack as vapor but condense at normal atmospheric temperatures to form liquid particles or mist that creates a visible blue haze. Both the VOCs and condensible PM are primarily compounds evaporated from the wood, with a minor constituent being combustion products. Quantities emitted are dependent on wood species, dryer temperature, fuel used, and other factors including season of the year, time between logging and processing, and wafer storage time.

Emissions from board hot presses are dependent on the type and amount of resin used to bind the wood particles together, as well as wood species, wood moisture content, wax and catalyst application rates, and press conditions. When the press opens, vapors that may include resin ingredients such as formaldehyde, phenol, methylene diphenyl diisocyanate (MDI), and other VOCs are released. The rate at which formaldehyde is emitted during pressing and board cooling operations is a function of the amount of excess formaldehyde in the resin, board thickness, press temperature, press cycle time, and catalyst application rates.

Emissions from finishing operations for WB/OSB products are dependent on the type of products being finished. For most WB/OSB products, finishing involves trimming to size and possibly painting or coating the edges. Trimming and sawing operations are sources of PM and PM-10 emissions. In addition, these processes may be sources of PM less than 2.5 micrometers in aerodynamic diameter (PM-2.5) emissions. No data specific to WB/OSB panel trimming or sawing are available. However, emission factors for sawing operations at plywood or medium density fiberboard (MDF) plants may provide an order of magnitude estimate for similar WB/OSB sawing and trimming operations. It is expected that water-based coatings are used to paint WB/OSB edges, and the resultant VOC emissions are relatively small.

PM, PM-10, and PM-2.5 emissions from log debarking, sawing, and waferizing operations can be controlled through capture in an exhaust system connected to a sized cyclone and/or fabric filter collection system. Emissions of PM, PM-10, and PM-2.5 from final trimming operations can be controlled using similar methods. These wood dust capture and collection systems are used not only to control atmospheric emissions, but also to recover the dust as a by-product fuel for a boiler or dryer.

Methods of controlling PM emissions from WB/OSB sources include multiclones, absorption systems (wet scrubbers), fabric filters, electrified filter beds (EFBs), wet electrostatic precipitators (WESPs), and oxidation systems (discussed below). WESPs are commonly used on OSB rotary dryer effluent gas streams that contain sticky, condensible hydrocarbon pollutants. Gases exiting the dryer enter a prequench to cool and saturate the gases before they enter the WESP. The prequench is essentially a low-energy scrubber that sprays water into the incoming gas stream. Some fraction of the highly water-soluble compounds, such as formaldehyde and methanol, may be scrubbed by the prequench and collected. However, the ability of the WESP to absorb water-soluble compounds diminishes as the recirculating liquid becomes saturated with these compounds. The WESP collects only particles and droplets that can be electrostatically charged; vaporous components of the gas stream that do not condense are not collected by the device. One disadvantage of the WESP is that it generates a wastewater effluent. Because OSB mills are generally designated as zero discharge facilities, they must treat their own spray water and/or consume it internally. Mills that operate boilers or other wet cell burners can apply some of the spent spray water to the fuel. Some or all of the remaining spray water may be used as makeup water in hot ponds or in debarkers for dust control.

A VOC control technology commonly used in the wood products industry for controlling both dryer and press exhaust gases is regenerative thermal oxidation. Thermal oxidizers destroy VOCs and condensible organics by burning them at high temperatures. Thermal oxidizers also reduce CO emissions in direct-fired dryer exhausts by oxidizing the CO in the exhaust to CO_2 (a product of complete combustion). Regenerative thermal oxidizers (RTOs) are designed to preheat the inlet emission stream with heat recovered from the incineration exhaust gases. Up to 98 percent heat recovery is possible, although 95 percent is typically specified. Gases entering an RTO are heated by passing through pre-heated beds packed with a ceramic media. A gas burner brings the preheated emissions up to an incineration temperature between 788° and 871°C (1450° and 1600°F) in a combustion chamber with sufficient gas residence time to complete the combustion. Combustion gases then pass through a cooled ceramic bed where heat is extracted. By reversing the flow through the beds, the heat transferred from the combustion exhaust air preheats the gases to be treated, thereby reducing auxiliary fuel requirements.

Regenerative catalytic oxidizers (RCOs) are also used to control VOCs from wood products dryers and presses. Regenerative catalytic oxidizers function similar to RTOs, except that the heat recovery beds in RCOs contain catalytic media. The catalyst accelerates the rate of VOC oxidation and allows for VOC destruction at lower temperatures than in an RTO, typically 316° to 538°C (600° to 1,000°F), which reduces auxiliary fuel usage.

Thermal catalytic oxidizers (TCOs), which are a combination of an RTO and RCO, are also used in the wood products industry. The TCO operates at a temperature of around 480°C (900°F) and contains catalytic media. However, the heat recovery canisters and fans on the TCO are sized large enough so that the TCO can be operated like an RTO (with non-catalytic ceramic media) if catalyst replacement costs become overly expensive.

Another technology for control of OSB dryer VOC and CO emissions is the use of a heat/energy system that accommodates exhaust gas recycle. This technology uses an oversized combustion unit that can accommodate 100 percent recirculation of dryer exhaust gases. The recirculated dryer exhaust is

mixed with combustion air and exposed directly to the burner flame. VOC emissions from burner combustion are incinerated in the second stage of the unit. High temperature exhaust from the combustion unit passes through a heat exchanger, which provides heat for dryer inlet air, and then through an add-on device for PM emission control. Plants that use exhaust gas recycle to control dryer emissions are generally designed from the ground up (i.e., exhaust gas recycle systems cannot be easily retrofitted).

Biofiltration systems are also used effectively for control of a variety of pollutants including organic compounds, NO_x, CO, and PM from press exhaust streams. Biofiltration uses microorganisms immobilized in a biofilm layer on a porous packing such as bark, wood chips, or synthetic media. Typical biofilter design consists of a three- to six-foot deep bed of media suspended over an air distribution plenum. Exhaust gases entering the plenum are evenly distributed through the moist biofilter media. As the contaminated vapor stream passes through the biofilter media, pollutants are transferred from the vapor to the biofilm and, through microbiological degradation, are converted to CO_2, water, and salts. The microorganisms cannot easily attack pollutants in the gas phase; therefore, less water soluble compounds (such as pinenes) are generally more difficult to control using a biofilter than are the more water-soluble compounds (such as formaldehyde).

Fugitive PM emissions from road dust and uncovered bark and dust storage piles may be controlled in a number of different ways. Some of these methods include enclosure, wet suppression systems, and chemical stabilization.

Calculating PM-10 emissions from wood products industry emission sources is problematic due to the relationship between PM-10 (or PM) emissions and VOC emissions from these processes. Because the Method 201A train (PM-10) operates with an in-stack cyclone and filter, organic materials that are volatile at stack gas temperatures but that are condensed at back half impinger temperatures (~20°C [~68°F]) are collected as condensible PM-10. However, these materials will also be measured as VOC via Methods 25 and 25A, which operate with a heated or an in-stack filter. Hence, if PM-10 is calculated as the sum of filterable and condensible material, some pollutants will be measured as both PM-10 and VOC emissions. However, if only filterable material is considered to be PM-10, the PM-10 emission factors will be highly dependent on stack gas temperature. In this AP-42 section, PM-10 is reported as front half catch only (Method 201A results only; not including Method 202 results). However, condensible PM results are also reported, and these results can be combined with the PM-10 results as appropriate for a specific application. Measured VOC emissions may be affected by the sampling method and by the quantity of formaldehyde and other aldehydes and ketones in the exhaust; formaldehyde is not quantified using Method 25A. Other low molecular weight oxygenated compounds have reduced responses to Method 25A. Therefore, when VOC emissions are measured using Method 25A, the emission rates will be biased low if low molecular weight oxygenated compounds are present in significant concentrations in the exhaust stream. A more extensive discussion of these sampling and analysis issues is provided in the Background Report for this section.

Guidance from EPA's Emission Factor and Inventory Group (EFIG) indicates that when it is possible, VOC emission factors should be reported in terms of the actual weight of the emitted compound. However, when an actual molecular weight (MW) of the emitted stream is not feasible (as is the case with the mixed streams emitted from wood products industry sources), the VOC should be reported using an assumed MW of 44, and reported "as propane." Each VOC-as-propane emission factor is estimated by first converting the THC from a carbon basis to a propane basis. Propane (MW = 44) includes 3 carbon atoms (total MW of 36) and 8 hydrogen atoms (total MW of 8). Every 36 pounds of carbon measured corresponds to 44 pounds of propane. The ratio of the MW of propane to the MW of carbon in propane is 44/36, or 1.22. The conversion is expressed by the following equation:

$$\text{THC as pounds carbon} \times \frac{\text{44 pounds propane}}{\text{36 pounds carbon}} = \text{THC as pounds propane}$$

or

$$\text{THC as pounds carbon} \times 1.22 = \text{THC as pounds propane}$$

After the THC emission factor has been converted from a carbon to a propane basis, the formaldehyde emission factor is added (where available), then the available emission factors for non-VOC compounds, including acetone, methane, and methylene chloride, are subtracted. This procedure is expressed simply by the following equation:

$$\text{VOC as propane} = (1.22 \times \text{THC as carbon}) + \text{formaldehyde} - (\text{acetone} + \text{methane} + \text{methylene chloride})$$

In cases where no emission factor is available (or the emission factor is reported only as below the test method detection limit, or "BDL") for one or more of the compounds used to estimate the VOC-as-propane value, adjustments to the converted THC value are made only for those compounds for which emission factors are available. That is, a value of zero is inserted in the above equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as BDL. For example, if no methane emission factor is available, the THC-as-carbon emission factor is converted to THC-as-propane, formaldehyde is added, and only acetone and methylene chloride are subtracted.

Table 10.6.1-1 presents emission factors for dryer emissions of PM, including filterable PM, filterable PM-10, and condensible PM. Table 10.6.1-2 presents emission factors for dryer emissions of SO_2, NO_x, CO, and CO_2. Table 10.6.1-3 presents emission factors for dryer emissions of organic compounds, some of which are listed as HAPs under section 112(b) of the Clean Air Act. The emission factors for dryer emissions are presented in units of pounds of pollutant per oven-dried ton of wood material out of the dryer (lb/ODT). Table 10.6.1-4 presents emission factors for press emissions of PM, including filterable PM, filterable PM-10, and condensible PM. Table 10.6.1-5 presents emission factors for press emissions of SO_2, NO_x, CO, and CO_2. Table 10.6.1-6 presents emission factors for press emissions of organic compounds, some of which are listed as HAPs in the Clean Air Act. The units for the press emission factors are pounds of pollutant per thousand square feet of 3/8-inch thick panel produced (lb/MSF 3/8). Table 10.6.1-7 presents emission factors for miscellaneous OSB manufacturing sources. Some of these compounds also are listed HAPs. The emission factors presented in Table 10.6.1-7 for blenders, sanderdust metering bins, and raw fuel bins are based on tests conducted at one facility using the press production rate at the time of the tests. Because of differences in plant configuration and the lack of specific process data for the material handling systems tested, these emission factors may not be representative of other facilities.

To the extent possible, separate emission factors for OSB dryers are presented in Tables 10.6.1-1 to -3 for hardwoods and softwoods. For OSB, plywood, and other composite wood products, commonly used hardwoods include aspen, oak, poplar, maple, cherry, alder, hickory, gum, beech, birch, and basswood. The emission factors for hardwood OSB dryers presented in this section are based largely on the drying of aspen furnish. For OSB, plywood, and other composite wood products, commonly used softwoods include pines, firs, and spruce. Pines are the most commonly used softwood species for OSB manufacturing. Firs and spruce are also used to produce OSB.

Emission factors for every possible mix of hardwood and softwood species cannot be reported in this section. Emission factors for specific mixes of wood species may be calculated by combining emission factors for individual wood species in the ratio specific to a given application, as emission data for those species become available. For example, an uncontrolled THC as carbon emission factor for a direct wood-fired rotary dryer processing 60 percent softwood and 40 percent hardwood may be

calculated using the uncontrolled THC as carbon emission factors for softwood (6.7 lb/ODT) and hardwood (1.7 lb/ODT), and the ratio of 60 percent to 40 percent. The resultant emission factor, rounded to two significant figures, would be 4.7 lb/ODT.

Table 10.6.1-1. EMISSION FACTORS FOR OSB DRYERS--PARTICULATE MATTER[a]

Source	Emission control device[c]	Filterable[b] PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING	Condensible[d]	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, softwood (SCC 3-07-010-09)	Uncontrolled	4.1[e]	C	2.5[f,g]	D	1.5[e]	C
	MCLO	2.3[h]	C	ND		0.51[j]	B
	EFB	0.56[k]	D	ND		0.48[k]	D
	WESP	0.43[m]	D	ND		0.46[m]	D
	RTO	0.30[n]	D	ND		0.10[n]	D
	WESP/RTO	0.051[p]	E	ND		0.098[p]	E
Rotary dryer, direct wood-fired, hardwood (SCC 3-07-010-10)	Uncontrolled	4.2[q]	D	ND		1.9[r]	E
	MCLO	5.2[s]	D	ND		0.38[k]	E
	EFB	0.93[t]	C	1.0[k]	D	0.45[t]	C
	WESP	0.25[u]	C	ND		0.38[v]	D
	EFB/RTO	0.51[w]	D	ND		ND	
	WESP/RTO	0.049[x]	D	ND		0.12[r]	E
Rotary dryer, direct wood-fired, mixed species (40-60% softwood, 40-60% hardwood) (SCC 3-07-010-15)	Uncontrolled	4.7[k]	D	ND		1.1[k]	E
	MCLO	3.3[y]	E	ND		1.5[y]	E
	SCBR	1.3[z]	E	ND		ND	
	EFB	0.42[y]	E	ND		0.75[y]	E
	WESP	0.66[aa]	D	ND		0.36[k]	E
Rotary dryer, indirect-heated, hardwood (SCC 3-07-010-30)	INCIN	0.024[bb]	E	ND		ND	
Conveyor dryer, indirect-heated, heated zones, hardwood (SCC 3-07-010-40)	Uncontrolled	0.72[cc]	E	0.062[cc]	E	0.028[cc]	D

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. See Table 10.6.1-8 for the hardwood and softwood species commonly used in the production of OSB and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] Emission control device: MCLO = multiclone; EFB = electrified filter bed; WESP = wet electrostatic precipitator; RTO = regenerative thermal oxidizer; SCBR = wet scrubber; INCIN = exhaust vented through a combustion unit (this combustion unit is controlled with a multiclone followed by a dry

Table 10.6.1-1 (cont.).

electrostatic precipitator). Cyclones are used as product recovery devices and are not considered to be emission control equipment.

[d] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

[e] References 6, 7, 8, 9, 10, and 11.

[f] Multiclones are used for PM; effects on PM-10 are considered negligible.

[g] References 12, 13, 14, and 15.

[h] References 11, 12, 13, 14, and 16.

[j] References 11, 12, 13, 14, 15, and 16.

[k] Reference 11.

[m] References 6, 7, and 11.

[n] References 8, 9, 10, and 17.

[p] References 6 and 7.

[q] References 18 and 19.

[r] Reference 19.

[s] References 11, 18, and 20.

[t] References 11, 21, 22, 23, and 24.

[u] References 11, 19, 20, 25, 26, 27, 28, 29, 30, and 31.

[v] References 11, 19, 26, 27, 28, 29, 30, and 31.

[w] Reference 18.

[x] References 19, 25, and 32.

[y] Reference 33.

[z] Reference 34.

[aa] References 11 and 35.

[bb] Reference 36.

[cc] Reference 37. Emission factors apply only to the heated zones of the dryer; the cooling sections also have emissions but data were not available for cooling section emissions.

Table 10.6.1-2. EMISSION FACTORS FOR OSB DRYERS--SO_2, NO_x, CO, AND CO_2 [a]

Source	Emission control device[b]	SO_2	EMISSION FACTOR RATING	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, softwood (SCC 3-07-010-09)	Uncontrolled RTO	ND ND		0.70[c] 0.78[f]	C D	5.3[d] 1.8[g]	B D	600[e] 720[h]	C D
Rotary dryer, direct wood-fired, hardwood (SCC 3-07-010-10)	Uncontrolled RTO	ND 0.014[n]	E	0.63[j] 0.42[p]	B D	5.5[k] 1.5[q]	B D	680[m] 780[p]	B C
Rotary dryer, direct wood-fired, mixed species (40-60% softwood, 40-60% hardwood) (SCC 3-07-010-15)	Uncontrolled	ND		0.51[r]	D	5.9[r]	D	670[s]	E
Rotary dryer, direct natural gas-fired, hardwood (SCC 3-07-010-20)	Uncontrolled	ND		0.68[t]	E	0.72[u]	D	330[v]	E
Rotary dryer, indirect-heated, hardwood (SCC 3-07-010-30)	INCIN	0.0026[w]	E	0.74[w]	E	0.13[w]	E	600[w]	E

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. See Table 10.6.1-8 for the hardwood and softwood species commonly used in the production of OSB and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] Emission control device: RTO = regenerative thermal oxidizer; INCIN = exhaust vented through a combustion unit (this combustion unit is controlled with a multiclone followed by a dry electrostatic precipitator).

[c] References 6, 7, 8, 10, 11, and 17.

[d] References 6, 7, 8, 10, 11, 12, 13, 16, 17, and 38.

[e] References 6, 7, 12, 13, and 16.
[f] References 6, 7, 8, 10, and 17.
[g] References 6, 7, 8, 10, 17, and 38.
[h] References 6, 7, and 17.
[j] References 11, 18, 19, 20, 21, 22, 23, 24, 25, 32, 39, and 40.
[k] References 11, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 32, 38, and 39.
[m] References 18, 19, 20, 21, 22, 23, 24, 25, 27, 29, 31, 32, and 40.
[n] Reference 19.
[p] References 18, 19, 25, 32, and 41.
[q] References 18, 19, 25, 32, 38, and 41.
[r] References 11 and 33.
[s] Reference 33.
[t] Reference 42.
[u] References 39 and 42.
[v] Reference 39.
[w] Reference 36.

Table 10.6.1-3. EMISSION FACTORS FOR OSB DRYERS--ORGANICS[a]

Source	Emission control device[b]	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, softwood (SCC 3-07-010-09)	Uncontrolled		THC as carbon[d]	6.7[f]	B
			VOC as propane[e]	8.1	C
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
		13466-78-9	3-Carene	0.066	D
		75-07-0	Acetaldehyde *	0.11	D
		67-64-1	Acetone	0.16	D
		107-02-8	Acrolein *	0.072	D
		80-56-8	Alpha-pinene	2.9	D
		71-43-2	Benzene *	0.0067	D
		127-91-3	Beta-pinene	1.0	D
			Bromomethane *	BDL	
		79-92-5	Camphene	0.068	D
			Chloroethane *	BDL	
			Chloroethene *	BDL	
		156-59-2	Cis-1,2-dichloroethylene	0.0022	D
		98-82-8	Cumene *	0.055	D
		50-00-0	Formaldehyde *	0.13[g]	B
		138-86-3	Limonene	0.14	D
		67-56-1	Methanol *	0.10	D
		78-93-3	Methyl ethyl ketone *	0.0089	D
		108-10-1	Methyl isobutyl ketone *	0.0078	D
			Methylene chloride *	BDL	
		1330-20-7	m,p-Xylene *	0.010	D
			o-Xylene *	BDL	
		99-87-6	p-Cymene	0.067	D
		99-83-2	p-Mentha-1,5-diene	0.063	D
		108-95-2	Phenol *	0.015	D
		123-38-6	Propionaldehyde *	0.011	D
			Styrene *	BDL	
		108-88-3	Toluene *	0.015	D

Table 10.6.1-3 (cont.)

Source	Emission control device[b]	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, softwood (SCC 3-07-010-09)	RTO		THC as carbon[d]	0.25[h]	D
			VOC as propane[e]	0.32	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.011	D
		67-64-1	Acetone	0.0076	D
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.020[j]	D
			Limonene	BDL	
		67-56-1	Methanol *	0.0082	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.021	D
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.1-3 (cont.)

Source	Emission control device[b]	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, hardwood (SCC 3-07-010-10)	Uncontrolled		THC as carbon[d]	1.7[k]	B
			VOC as propane[e]	2.1	C
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.62	E
		67-64-1	Acetone	0.041	E
		107-02-8	Acrolein *	0.20	E
			Alpha-pinene	BDL	
		71-43-2	Benzene *	0.010[m]	D
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.11[n]	B
			Limonene	BDL	
		67-56-1	Methanol *	0.33	E
		78-93-3	Methyl ethyl ketone *	0.0071	E
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.028	E
		123-38-6	Propionaldehyde *	0.034	E
		100-42-5	Styrene *	0.0034	E
		108-88-3	Toluene *	0.013	E

Table 10.6.1-3 (cont.)

Source	Emission control device[b]	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, hardwood (SCC 3-07-010-10)	RTO		THC as carbon[d]	0.15[p]	D
			VOC as propane[e]	0.26	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.11	E
		67-64-1	Acetone	0.012	E
		107-02-8	Acrolein *	0.031	E
			Alpha-pinene	BDL	
		71-43-2	Benzene *	0.0041[q]	D
			Benzo-a-pyrene	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.092[r]	D
			Limonene	BDL	
		67-56-1	Methanol *	0.072	E
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.0085[s]	D
		123-38-6	Propionaldehyde *	0.0075	E
			Styrene *	BDL	
			Toluene *	BDL	
Rotary dryer, direct wood-fired, mixed species (40-60% softwood, 40-60% hardwood) (SCC 3-07-010-15)	Uncontrolled		THC as carbon[d]	3.4[t]	D
			VOC as propane[e]	4.4	E
		75-07-0	Acetaldehyde *	0.11[u]	D
		67-64-1	Acetone	0.039[u,v]	E
		107-02-8	Acrolein *	0.033[u,v]	E
		123-72-8	Butylaldehyde	0.017[u,v]	E
		4170-30-3	Crotonaldehyde	0.011[u,v]	E
		50-00-0	Formaldehyde *	0.34[u]	D
		123-38-6	Propionaldehyde *	0.0098[u]	D

Table 10.6.1-3 (cont.)

Source	Emission control device[b]	CASRN[c]	Pollutant	Emission factor	EMISSION FACTOR RATING
Rotary dryer, direct natural gas-fired, hardwood (SCC 3-07-010-20)	Uncontrolled	50-00-0	Formaldehyde *	0.036[w]	E
Rotary dryer, indirect heated, hardwood (SCC 3-07-010-30)	INCIN		THC as carbon[d]	0.013[x]	E
			VOC as propane[e]	0.018	E
		50-00-0	Formaldehyde *	0.0022[x]	E
Conveyor dryer, indirect heated, heated zones, hardwood[z] (SCC 3-07-010-40)	Uncontrolled		THC as carbon[d]	0.42[y]	E
			VOC as propane[e]	0.51	E
		50-00-0	Formaldehyde *	0.0024[y]	E

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 38 unless otherwise noted. See Table 10.6.1-8 for the hardwood and softwood species commonly used in the production of OSB and other composite wood products. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] Emission control device: RTO = regenerative thermal oxidizer; INCIN = exhaust vented through a combustion unit (this combustion unit is controlled with a multiclone followed by a dry electrostatic precipitator).

[c] CASRN = Chemical Abstracts Service Registry Number.

[d] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

[e] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".

[f] References 6, 7, 10, 11, 12, 13, 14, 16, 17, and 38.

[g] References 6, 7, 8, 9, 10, 11, 12, 13, 14, 38, and 43.

[h] References 6, 7, 10, 17, and 38.

[j] References 6, 7, 8, 9, 10, and 38.

[k] References 11, 18, 19, 21, 22, 23, 24, 25, 26, 29, 32, 38, 44, and 45.

[m] References 20 and 38.

[n] References 11, 19, 20, 21, 22, 23, 24, 26, 27, 29, 38, and 44.

[p] References 18, 19, 25, 32, 38, and 41.

[q] References 18, 32, and 38.

[r] References 18, 19, 25, 32, and 38.

[s] References 18, 25, 32, and 38.

[t] References 11 and 33.

[u] Reference 11.

Table 10.6.1-3 (cont.)

[v] Based on M0011 data only; suspected to be biased low due to poor collection efficiency or analytical problems.
[w] Reference 42.
[x] Reference 36.
[y] Reference 37.
[z] Emission factors apply only to the heated zones of the dryer; the cooling sections also have emissions but data were not available for cooling section emissions.

Table 10.6.1-4. EMISSION FACTORS FOR OSB PRESSES--PARTICULATE MATTER[a]

Source[c]	Emission control device[d]	Filterable[b]				Condensible[e]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Hot press, PF resin (liquid) (SCC 3-07-010-53)	Uncontrolled	0.12[f]	D	0.10[f]	E	ND	
Hot press, PF resin (powder) (SCC 3-07-010-54)	Uncontrolled	0.11[g]	E	ND		ND	
Hot press, MDI resin (SCC 3-07-010-55)	Uncontrolled	0.13[h]	D	ND		0.020[h]	D
Hot press, PF/MDI resins (SCC 3-07-010-57)	Uncontrolled RTO	0.37[j] 0.049	B D	0.11[f] ND	E	0.15[k] 0.093[n]	B D

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/8-inch thick panel (lb/MSF 3/8). One lb/MSF 3/8 = 0.5 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Filterable PM-10 is that PM collected on the filter, or in the sample line between the cyclone and filter of an EPA Method 201 or 201A sampling train.

[c] PF = phenol formaldehyde; MDI = Methylene diphenyl diisocyanate; PF/MDI = PF resin in surface layers, MDI resin in core layers.

[d] Emission control device: RTO = regenerative thermal oxidizer.

[e] Condensible PM is that PM collected in the impinger portion of a PM sampling train (EPA Method 202).

[f] Reference 11.

[g] Reference 36.

[h] References 11, 19, and 45.

[j] References 11, 14, 20, 26, 27, 29, 39, 46, 47, 48, 49, 50, 51, 52, and 53.

[k] References 11, 14, 26, 27, 29, 39, 47, 48, 49, 52, and 53.

[m] References 6, 7, 17, 25, 32, 46, 47, 48, 49, and 52.

[n] References 6, 7, 17, 47, 48, 49, and 52.

Table 10.6.1-5. EMISSION FACTORS FOR OSB PRESSES--SO_2, NO_x, CO, AND CO_2 [a]

Source[b]	Emission control device[c]	SO_2	EMISSION FACTOR RATING	NO_x	EMISSION FACTOR RATING	CO	EMISSION FACTOR RATING	CO_2[j]	EMISSION FACTOR RATING
Hot press, PF resin (liquid) (SCC 3-07-010-53)	Uncontrolled RTO	ND ND		0.049[d] 0.35[e]	D E	0.095[d] 0.21[e]	D E	NA 62.2[e]	D
Hot press, PF resin (powder) (SCC 3-07-010-54)	Uncontrolled	ND		0.0014[f]	E	0.0026[f]	E	NA	
Hot press, MDI resin (SCC 3-07-010-55)	Uncontrolled	ND		0.019[g]	D	0.11[h]	D	NA	
Hot press, PF/MDI resins (SCC 3-07-010-57)	Uncontrolled RTO	0.037[k] ND	E	0.041[m] 0.27[p]	D D	0.10[n] 0.22[q]	B D	NA 40.3[r]	C

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/8-inch thick panel (lb/MSF 3/8). One lb/MSF 3/8 = 0.5 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. ND = no data available. NA = not applicable. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] PF = phenol formaldehyde; MDI = Methylene diphenyl diisocyanate; PF/MDI = PF resin in surface layers, MDI resin in core layers.

[c] Emission control device: RTO = regenerative thermal oxidizer.

[d] References 11 and 32.

[e] Reference 32.

[f] Reference 36.

[g] References 19 and 45.

[h] References 11, 19, and 45.

[j] CO_2 emission factors are presented for RTO-controlled presses only. CO_2 concentrations from uncontrolled presses should be near ambient levels.

[k] References 54 and 55.

[m] References 6, 7, 25, 52, 54, 55, and 56.

[n] References 6, 7, 20, 21, 22, 23, 24, 27, 29, 39, 46, 47, 48, 49, 50, 51, 53, 57, 58, and 59.

[p] References 6, 7, 17, 25, 46, 52, and 56.

[q] References 6, 7, 17, 25, 38, 46, 49, 52, and 56.

[r] References 6, 7, 17, 25, 32, 46, and 49.

Table 10.6.1-6. EMISSION FACTORS FOR OSB PRESSES--ORGANICS[a]

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Hot press, PF resin (liquid) (SCC 3-07-010-53)	Uncontrolled		THC as carbon[e]	0.14[g]	D
			VOC as propane[f]	0.21	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.0052	E
		67-64-1	Acetone	0.0035	E
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.044[h]	D
			Limonene	BDL	
		64-56-1	Methanol *	0.50	E
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.072[h]	D
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.1-6 (cont.).

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Hot press, PF resin (liquid) (SCC 3-07-010-53)	Biofilter		THC as carbon[e]	0.053	E
			VOC as propane[f]	0.061	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.0037	E
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
			Formaldehyde *	BDL	
			Limonene	BDL	
		67-56-1	Methanol *	0.10	E
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	
Hot press, PF resin (liquid) (SCC 3-07-010-53)	RTO	50-00-0	Formaldehyde *	0.0042[j]	E
		101-68-8	MDI *	BDL	
Hot press, PF resin (powder) (SCC 3-07-010-54)	Uncontrolled	50-00-0	Formaldehyde *	0.14[k]	E
Hot press, MDI resin (SCC 3-07-010-55)	Uncontrolled		THC as carbon[e]	0.11[m]	D
			VOC as propane[f]	0.20	E
		50-00-0	Formaldehyde *	0.064[n]	D
		101-68-8	MDI *	0.0021[p]	E

Table 10.6.1-6 (cont.).

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Hot press, PF/MDI resins (SCC 3-07-010-57)	Uncontrolled		THC as carbon[e]	0.51[q]	B
			VOC as propane[f]	0.67	C
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
		75-07-0	Acetaldehyde *	0.010	D
		67-64-1	Acetone	0.011	D
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	0.32	D
			Benzene *	BDL	
		127-91-3	Beta-pinene	0.12	D
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.056[r]	B
			Limonene	BDL	
		101-68-8	MDI *	0.0011[s]	D
		67-56-1	Methanol *	0.25	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.015[t]	C
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.1-6 (cont.).

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Hot press, PF/MDI resins (SCC 3-07-010-57)	RCO		THC as carbon[e]	0.056	E
			VOC as propane[f]	0.086	E
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.0062	E
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.024	E
			Limonene	BDL	
		67-56-1	Methanol *	0.040	E
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.0068	E
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.1-6 (cont.).

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Hot press, PF/MDI resins (SCC 3-07-010-57)	RTO		THC as carbon[e]	0.025[u]	C
			VOC as propane[f]	0.027	D
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.0071	D
			Acrolein *	BDL	
			Alpha-pinene	BDL	
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.0038[v]	C
			Limonene	BDL	
		101-68-8	MDI *	9.7E-6[w]	E
		67-56-1	Methanol *	0.0062	D
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
		108-95-2	Phenol *	0.0087[x]	D
			Propionaldehyde *	BDL	
			Stryene *	BDL	
			Toluene *	BDL	

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/8-inch thick panel (lb/MSF 3/8). One lb/MSF 3/8 = 0.5 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. SCC = Source Classification Code. * = hazardous air pollutant. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. Reference 38 unless otherwise noted. **Note: emission factors in table represent averages of data sets. The data spreadsheets, which may be more useful for specific applications, are available on EPA's Technology Transfer Network (TTN) website at: http://www.epa.gov/ttn/chief/.**

[b] PF = phenol formaldehyde; MDI = Methylene diphenyl diisocyanate; PF/MDI = PF resin in surface layers, MDI resin in core layers.

[c] Emission control device: RCO = regenerative catalytic oxidizer; RTO = regenerative thermal oxidizer.

[d] CASRN = Chemical Abstracts Service Registry Number.

Table 10.6.1-6 (cont.).

[e] THC as carbon = total hydrocarbon measurements using EPA Method 25A.
[f] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as "BDL".
[g] References 11, 32, and 38.
[h] References 11 and 38.
[j] Reference 32.
[k] Reference 36.
[m] References 19 and 45.
[n] References 11 and 19.
[p] Reference 19.
[q] References 6, 7, 11, 14, 17, 21, 22, 23, 24, 25, 26, 27, 29, 38, 46, 47, 48, 49, 50, 51, 52, 54, 55, 57, and 58.
[r] References 6, 7, 11, 14, 20, 21, 22, 23, 24, 26, 27, 29, 38, 49, 50, 51, 54, 55, 56, and 57.
[s] References 22, 23, 24, 26, 29, 49, 54, and 55.
[t] References 21, 22, 23, 24, 38, 49, 50, 51, and 57.
[u] References 6, 7, 17, 25, 32, 38, 46, 47, 48, 49, and 52.
[v] References 6, 7, 25, 38, 46, 49, 52, and 56.
[w] Reference 49.
[x] References 38 and 49.

Table 10.6.1-7. EMISSION FACTORS FOR OSB MISCELLANEOUS SOURCES[a]

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Log storage (SCC 3-07-008-95)	Uncontrolled		PM, THC, VOC	ND	
Log cutting (SCC 3-07-008-02)	Uncontrolled		PM, THC, VOC	ND	
Log debarking (SCC 3-07-008-01)	Uncontrolled		PM, THC, VOC	ND	
Blender (PF & MDI) (SCC 3-07-010-60) Use with caution![e]	Uncontrolled		THC as carbon[f]	0.13	U
			VOC as propane[g]	0.16	U
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.0018	U
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	0.064	U
			Benzene *	BDL	
		127-91-3	Beta-pinene	0.019	U
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.0036	U
			Limonene	BDL	
		67-56-1	Methanol *	0.063	U
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.1-7 (cont.).

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Sanderdust metering bin[h] (SCC 3-07-010-62) Use with caution![e]	Uncontrolled		THC as carbon[f]	0.095	U
			VOC as propane[g]	0.12	U
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
			Acetone	BDL	
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	0.046	U
			Benzene *	BDL	
		127-91-3	Beta-pinene	0.013	U
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
			Formaldehyde *	BDL	
			Limonene	BDL	
		67-56-1	Methanol *	0.00073	U
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

Table 10.6.1-7 (cont.).

Source[b]	Emission control device[c]	CASRN[d]	Pollutant	Emission factor	EMISSION FACTOR RATING
Raw fuel bin[j] (SCC 3-07-010-64) Use with caution![e]	Uncontrolled		THC as carbon[f]	0.050	U
			VOC as propane[g]	0.060	U
			1,2-Dichloroethane *	BDL	
			1,2,4-Trichlorobenzene *	BDL	
			3-Carene	BDL	
			Acetaldehyde *	BDL	
		67-64-1	Acetone	0.0015	U
			Acrolein *	BDL	
		80-56-8	Alpha-pinene	0.032	U
			Benzene *	BDL	
			Beta-pinene	BDL	
			Bromomethane *	BDL	
			Camphene	BDL	
			Chloroethane *	BDL	
			Chloroethene *	BDL	
			Cis-1,2-dichloroethylene	BDL	
			Cumene *	BDL	
		50-00-0	Formaldehyde *	0.00030	U
			Limonene	BDL	
		67-56-1	Methanol *	0.0015	U
			Methyl ethyl ketone *	BDL	
			Methyl isobutyl ketone *	BDL	
			Methylene chloride *	BDL	
			m,p-Xylene *	BDL	
			o-Xylene *	BDL	
			p-Cymene	BDL	
			p-Mentha-1,5-diene	BDL	
			Phenol *	BDL	
			Propionaldehyde *	BDL	
			Styrene *	BDL	
			Toluene *	BDL	

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/8-inch thick panel (lb/MSF 3/8). One lb/MSF 3/8 = 0.5 kg/m^3. Factors represent uncontrolled emissions unless otherwise noted. ND = no data available. BDL = below test method detection limit; indicates that this pollutant has not been detected in any test runs on this source. SCC = Source Classification Code. * = hazardous air pollutant. U = emission factor unrated. Reference 38.

[b] PF = phenol formaldehyde; MDI = Methylene diphenyl diisocyanate.

[c] Emission control devices (baghouses) are considered no control for organic pollutants.

[d] CASRN = Chemical Abstracts Service Registry Number.

[e] Emission factors based on tests conducted at one facility using the press production rate at the time of the tests. Because of differences in plant configuration and the lack of specific process data for the material handling systems tested, these emission factors may not be representative of other facilities.

[f] THC as carbon = total hydrocarbon measurements using EPA Method 25A.

[g] VOC as propane = (1.22 × THC) + formaldehyde - (acetone + methane + methylene chloride); a value of zero is inserted in the equation for the specified compounds where no emission factor is available, or where the emission factor is reported only as “BDL”.

[h] Storage bin from which sanderdust, including pulverized board trim and dryer fines, is fed into a dryer suspension burner.

[j] Storage bin for board finishing trim material and fines collected from dryer exhaust cyclone.

Table 10.6.1-8. WOOD SPECIES COMMONLY USED IN COMPOSITE WOOD PRODUCTS MANUFACTURING [a]

Wood product	AP-42 section	Hardwood species	Softwood species
Plywood	10.5	Oak, cherry, poplar, maple, larch	Firs, pines
Oriented strandboard	10.6-1	Aspen	Pines, firs, spruce
Particleboard	10.6-2	Aspen, oak	Pines, firs
Medium density fiberboard	10.6-3	Gum, alder, hickory	Pines, firs
Hardboard/fiberboard	10.6-4	Aspen, birch, beech, oak, maple	Pines
Engineered wood products	10.9	Aspen, birch, poplar	Pines, firs, hemlock

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