

South Coast Air Quality Management District



Emissions Calculator References for Emission Factors

Emission Calculator Version 3

October 31, 2024

TABLE OF CONTENTS

OVERVIEW	3
Table 1: Boiler and Gaseous Fueled Fired (Natural Gas) Boilers	4
Table 2: Crematories	5
Table 3: Natural Gas Reciprocating Internal Combustion Engines (ICE), Including Lean Burn Internal Combustion Engines (ICE) and Rich Burn Internal Combustion Engines (ICE)	6
Table 4: Diesel Internal Combustion Engines (ICE) / Diesel Reciprocating Internal Combustion Engines (ICE)	7
Table 5: Diesel Pressure Washer	8
Table 6: Spray Booth (Burner Only)	9

OVERVIEW

The purpose of this document is to identify the emission factors used with the Emissions Calculator spreadsheet and the reference source for each. The most recently released version of the Emissions Calculator is Version 3. Subsequent versions where emission factors are added or updated will be represented as a higher number version release whereas minor edits, formatting, or interface updates will be represented as incremental version numbers (i.e., version 3.01, 3.02, 3.03, *et. seq.*) that can be found in the Revision History worktab of the Emissions Calculator spreadsheet.

The emission factors in this document and the associated Emissions Calculator spreadsheet are from reference materials reviewed by South Coast AQMD staff and approved for use in Rule 1401 health risk assessments. Please note that this summary, as well as the Emissions Calculator spreadsheet, does not encompass all possible equipment types. For equipment not listed, or where more applicable or recent supportable data is available, applicants can work with their respective permitting engineers to propose alternative emission factors with accompanying supporting references.

Table 1: Boiler and Gaseous Fueled Fired (Natural Gas) Boilers

Compound	CAS #	Boiler Rating		
		<10 mmbtu/hr Emission Factor (lbs/mmcf)	10-100 mmbtu/hr Emission Factor (lbs/mmcf)	<100 mmbtu/hr Emission Factor (lbs/mmcf)
Acetaldehyde	75-07-0	0.0043	0.0031	0.0009
Acrolein	107-02-8	0.0027	0.0027	0.0008
Ammonia	7664-41-7			
SNCR		18	18	18
SCR		9.1	9.1	9.1
OTHER		3.2	3.2	3.2
Benzene	71-43-2	0.008	0.0058	0.0017
Ethyl benzene	100-41-4	0.0095	0.0069	0.002
Formaldehyde	50-00-0	0.017	0.0123	0.0036
Hexane	110-54-3	0.0063	0.0046	0.0013
PAHs, total, w/o individual components reported [Treated as B(a)P for HRA]	1151*	0.0001	0.0001	0.0001
Naphthalene	91-20-3	0.0003	0.0003	0.0003
Toluene	108-88-3	0.0366	0.0265	0.0078
Xylenes (mixed)	1330-20-7	0.0272	0.0197	0.0058

Source: South Coast AQMD, “Reporting Procedures for AB2588 Facilities Reporting their Quadrennial Air Toxics Emissions Inventory, Table B-1: Default EF for Natural Gas Combustion (lb/mmcf), SOURCE: External Combustion Equipment (Boiler, Oven, Dryer, Furnace, Heater, Afterburner)”, December 2016. (<https://www.aqmd.gov/docs/default-source/planning/annual-emission-reporting/supplemental-instructions-for-ab2588-facilities.pdf#page=14>)

*This value represents a combined default emission factor for toxic compounds within the PAH family.

Table 2: Crematories

Compound	CAS #	Human Cremation	Animal Cremation
		Emission Factor (lbs/ton)	Emission Factor (lbs/ton)
Acetaldehyde	75-07-0	0.0015	0.0015
Arsenic	7440-38-2	0.00058	0.00058
Benzene	71-43-2	0.00072	0.00072
Beryllium	7440-41-7	0.00002	0.00002
Cadmium	7440-43-9	0.00016	0.00016
Chromium, hexavalent (& compounds)	18540-29-9	0.00019	0.00019
Copper	7440-50-8	0.0004	0.0004
Formaldehyde	50-00-0	0.0004	0.0004
Hydrochloric acid	7647-01-0	0.86	0.86
Hydrogen fluoride	7664-39-3	0.0078	0.0078
Lead	7439-92-1	0.00098	0.00098
Mercury	7439-97-6	0.00218	0
Nickel	7440-02-0	0.00057	0.00057
PAHs, total, w/o individual components reported [Treated as B(a)P for HRA]	1151*	0.000052	0.000052
Selenium	7782-49-2	0.00065	0.00065
Toluene	108-88-3	0.0099	0.0099
Xylenes (mixed)	1330-20-7	0.0028	0.0028
Zinc	-	0.00052	0.00052

Source: San Diego County Air Pollution Control District, “C01 – CREMATORY, NATURAL GAS FIRED, HUMAN REMAINS, CONTROLLED AIR”, April 20, 2022.

(<https://www.sdapcd.org/content/dam/sdapcd/documents/permits/emissions-calculation/incinerator-and-crematory/APCD-Crematory-Natural-Gas-Fired-Animal-Remains-Controlled-Air.pdf>) and San Diego County Air Pollution Control District, “C02 – CREMATORY, NATURAL GAS FIRED, ANIMAL REMAINS, CONTROLLED AIR”, April 20, 2022
(<https://www.sdapcd.org/content/dam/sdapcd/documents/permits/emissions-calculation/incinerator-and-crematory/APCD-Crematory-Natural-Gas-Fired-Animal-Remains-Controlled-Air.pdf>)

*This value represents a combined default emission factor for toxic compounds within the PAH family.

Table 3: Natural Gas Reciprocating Internal Combustion Engines (ICE), Including Lean Burn Internal Combustion Engines (ICE) and Rich Burn Internal Combustion Engines (ICE)

Compound	CAS #	Lean Burn		Rich Burn
		2-Stroke Emission Factor (lbs/mmcf)	4-Stroke Emission Factor (lbs/mmcf)	4-Stroke Emission Factor (lbs/mmcf)
Benzene	71-43-2	1.98	0.449	1.61
1,3-Butadiene	106-99-0	0.836	0.272	0.676
Carbon tetrachloride	56-23-5	0.0619	0.0374	0.0181
Ethylene dibromide {EDB}	106-93-4	0.0749	0.0452	0.0217
Ethylene dichloride {EDC}	107-06-2	0.043	0.0241	0.0115
Formaldehyde	50-00-0	56.3	53.9	20.9
Methylene chloride {Dichloromethane}	75-09-2	0.15	0.0204	0.042
Benz[a]anthracene	56-55-3	0.000343	0	0
Benzo[a]pyrene	50-32-8	0.00000579	0	0
Benzo[b]fluoranthene	205-99-2	0.00000868	0.000169	0
Benzo[k]fluoranthene	207-08-9	0.00000579	0	0
Chrysene	218-01-9	0.000685	0.000707	0
Indeno[1,2,3-cd]pyrene	193-39-5	0.0000101	0	0
Naphthalene	91-20-3	0.09823	0.0759	0.099
Vinyl chloride	75-01-4	0.0252	0.0152	0.00732
1,1,2,2-Tetrachloroethane	79-34-5	0.0676	0.0408	0.0258
1,1,2-Trichloroethane	79-00-5	0.0538	0.0324	0.0156
Acetaldehyde	75-07-0	7.92	8.53	2.85
Acrolein	107-02-8	7.94	5.24	2.68
Ammonia	7664-41-7			
SNCR		18	18	18
SCR		9.1	9.1	9.1
Other		3.2	3.2	3.2
Chloroform	67-66-3	0.048	0.0291	0.014
Ethyl benzene	100-41-4	0.11	0.0405	0.0253
Hexane	110-54-3	0.454	1.13	0
Methanol	67-56-1	2.53	2.55	3.12
Styrene	100-42-5	0.0559	0.0241	0.0121
Toluene	108-88-3	0.982	0.416	0.569
Xylenes (mixed)	1330-20-7	0.273	0.188	0.199

Source: South Coast AQMD, “Reporting Procedures for AB2588 Facilities Reporting their Quadrennial Air Toxics Emissions Inventory, Table B-1: Default EF for Natural Gas Combustion (lb/mmcf), SOURCE: Stationary and Portable Internal Combustion Engines (ICE)”, December 2016.

(<https://www.aqmd.gov/docs/default-source/planning/annual-emission-reporting/supplemental-instructions-for-ab2588-facilities.pdf#page=15>)

Table 4: Diesel Internal Combustion Engines (ICE) / Diesel Reciprocating Internal Combustion Engines (ICE)

PM Emission Factor Limits (g/bhp*hr)									
Based on CARB Off-Road Compression-Ignition (Diesel) Engine Standards									
Rating (BHP)	50-75	75-100	100-175	175-300	300-600	600-750	> 750	(750,1207]	> 1207
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.000	0.400	0.400	0.400	0.000	0.000	0.000
1997	0.000	0.000	0.000	0.400	0.400	0.400	0.000	0.000	0.000
1998	0.000	0.000	0.000	0.400	0.400	0.400	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.400	0.400	0.400	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.400	0.400	0.400	0.400	0.400	0.400
2001	0.000	0.000	0.000	0.400	0.150	0.400	0.400	0.400	0.400
2002	0.000	0.000	0.000	0.400	0.150	0.150	0.400	0.400	0.400
2003	0.000	0.000	0.220	0.150	0.150	0.150	0.400	0.400	0.400
2004	0.300	0.300	0.220	0.150	0.150	0.150	0.400	0.400	0.400
2005	0.300	0.300	0.220	0.150	0.150	0.150	0.400	0.400	0.400
2006	0.300	0.300	0.220	0.150	0.150	0.150	0.150	0.150	0.150
2007	0.300	0.300	0.220	0.150	0.150	0.150	0.150	0.150	0.150
2008	0.220	0.300	0.220	0.150	0.150	0.150	0.150	0.150	0.150
2009	0.220	0.300	0.220	0.150	0.150	0.150	0.150	0.150	0.150
2010	0.220	0.300	0.220	0.150	0.150	0.150	0.150	0.150	0.150
2011	0.220	0.300	0.220	0.015	0.015	0.015	0.070	0.070	0.070
2012	0.220	0.010	0.010	0.015	0.015	0.015	0.070	0.070	0.070
2013	0.020	0.010	0.010	0.015	0.015	0.015	0.070	0.070	0.070
2014	0.020	0.010	0.010	0.010	0.010	0.010	0.070	0.070	0.070
2015	0.020	0.010	0.010	0.010	0.010	0.010	0.030	0.020	0.020

Source: EPA, Office of Transportation and Air Quality, “EPA-420-B-16-022-EPA non-road engine exhaust emission standard for Diesel ICE based on engine HP, engine year built and engine type”, March 2016. (<http://www.arb.ca.gov/msprog/offroad/offroad.htm> & <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100OA05.pdf>)

Table 5: Diesel Pressure Washer

Compound	CAS #	Emission Rate (lbs/1,000 gal)
Benzene	71-43-2	0.00285
Ethyl Benzene	100-41-4	0.00165
Formaldehyde	50-00-0	1.75
n-Hexane	110-54-3	0.00134
Naphthalene	91-20-3	2.78
Polycyclic Aromatic Hydrocarbon (PAH)	1151*	0.000995
Propylene (Propene)	115-07-1	0.0018
Toluene	108-88-3	0.0017
Xylenes (Mixed Isomers)	1330-20-7	0.00165

Source: California Air Resources Board, California Air Toxics Emission Factor, <https://ww2.arb.ca.gov/california-air-toxics-emission-factor>

*This value represents a combined default emission factor for toxic compounds within the PAH family.

Table 6: Spray Booth (Burner Only)

Note: This is only representative of Natural Gas Combustion Emissions.

Compound	CAS #	Emission Rate (lbs/hr)
Acetaldehyde	75-07-0	0.0043
Acrolein	107-02-8	0.0027
Ammonia	7664-41-7	18
Benzene	71-43-2	0.008
Ethyl benzene	100-41-4	0.0095
Formaldehyde	50-00-0	0.017
Hexane	110-54-3	0.0063
PAHs, total, w/o individual components reported [Treated as B(a)P for HRA]	1151*	0.0001
Naphthalene	91-20-3	0.0003
Toluene	108-88-3	0.0366
Xylenes (mixed)	1330-20-7	0.0272

Source: South Coast AQMD, “Reporting Procedures for AB2588 Facilities Reporting their Quadrennial Air Toxics Emissions Inventory, Table B-1: Default EF for Natural Gas Combustion (lb/mm scf), External Combustion Equipment (Boiler, Oven, Dryer, Furnace, Heater, Afterburner)”, December 2016. (<https://www.aqmd.gov/docs/default-source/planning/annual-emission-reporting/supplemental-instructions-for-ab2588-facilities.pdf#page=14>)

*This value represents a combined default emission factor for toxic compounds within the PAH family.