

Attachment C-1

Construction Emission Factors

**Table EF-1
Fugitive PM₁₀ Emission Factors**

Trucks and Worker Buses on Unpaved Roads		
Parameter	Value	Source
Vehicle Weight (tons)	10	Assumption
Surface Silt Content (percent)	11	MDAQMD Default
Moisture Content (percent)	0.2	MDAQMD Default
Control Efficiency (percent)	50	Conservative Assumption
Emission Factor (lb/VMT)*	1.96	
* EF = 2.6 (silt loading/12) ^{0.8} (vehicle weight/3) ^{0.4} (moisture/0.2) ^{-0.3} (1-control efficiency/100)		
Source: AP-42, 13.2.2, Sept. 1998		
Construction Equipment on Unpaved Surfaces		
Parameter	Value	Source
Vehicle Weight (tons)	10	Assumption
Surface Silt Content (percent)	11	MDAQMD Default
Moisture Content (percent)	0.2	MDAQMD Default
Equipment Speed (miles/hour)	5	Typical for Construction
Control Efficiency (percent)	50	Conservative Assumption
Emission Factor (lb/VMT)*	0.65	
* EF = 2.6 (equipment speed/15) (silt loading/12)0.8 (vehicle weight/3)0.4 (moisture/0.2)-0.3 (1-control efficiency/100)		
Source: AP-42, 13.2.2, Sept. 1998		
Vehicles on Paved Roads		
Parameter	Value	Source
Mean Vehicle Weight (tons)	2.4	ARB Mean Value
Road Silt Loading (g/m ²)	0.4	AP-42 Low ADT
Emission Factor (lb/VMT)*	0.00402	
*EF = 0.016 (silt loading/2) ^{0.65} (vehicle weight/3) ^{1.5}		
Source: AP-42, 13.2.1, October 1997		
Bulldozing		
Parameter	Value	Source
Surface Silt Content (percent)	11	Same as Unpaved Road
Moisture Content (percent)	0.5	MDAQMD Default
Control Efficiency (percent)	50	Conservative Assumption
Emission Factor (lb/hr)*	36	
* EF = 0.75 (silt content) ^{1.5} (moisture) ^{-1.4} (1-control efficiency/100)		
Source: AP-42, 11.9, October 1998		

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Fugitive PM₁₀ Emission Factors**

Grading		
Parameter	Value	Source
Grader speed (miles/hour)	5	Typical for Construction
Control Efficiency (percent)	50	Conservative Assumption
Emission Factor (lb/VMT)*	0.388	
* EF = 0.0301 (grader speed) ² (1-control efficiency/100)		
Source: AP-42, 11.9, October 1998		
Scraping		
Parameter	Value	Source
Control Efficiency (percent)	50	Conservative Assumption
Emission Factor (lb/VMT)*	5.05	
*EF = 10.1 (1-control efficiency/100)		
Source: AP-42, 13.2.3, October 1998 with assumption that 50% of TSP is PM10		
Material Handling		
Parameter	Value	Source
Mean Wind Speed (miles/hour)	7.7	MDAQMD Default
Moisture Content (percent)	0.5	MDAQMD Default
Number Drops	2	Maximum per Load
Control Efficiency (percent)	50	Conservative Assumption
Emission Factor (lb/ton)*	0.0141	
*EF = 0.00115 (number drops) (wind speed/5) ^{1.3} (moisture/2) ^{-1.4} (1-control efficiency/100)		
Source: AP-42, 13.2.4, January 1995		
Disturbed Surface Wind Erosion		
Parameter	Value	Source
Vegetative Cover (fraction)	0	Conservative Assumption
Mean Wind Speed (m/s)	2.36	MDAQMD Default
Threshold Friction Velocity (m/s)	0.33	Disturbed Desert
Ratio of Wind Speed to Threshold Friction Velocity	15	Open Area
C(x)	0.4	
Emission Factor (lb/acre-day)*	0.33	
EF = 7.71 (1-vegetative cover) (wind speed/u _t) ³ C(x)		
u _t = (threshold friction velocity) (ratio of windspeed to threshold friction velocity)		
= 4.95		
x = 0.886 u _t / (mean wind speed)		
= 1.9		
Source: MDAQMD Emissions Inventory Guidance, Mineral Handling and Processing Industries, April 10, 2000		

**Table EF-2
Construction Equipment Exhaust Emission Factors**

Equipment	Horsepower	Load Factor (percent)	CO (lb/bhp-hr)	VOC (lb/bhp-hr)	NO_x (lb/bhp-hr)	SO_x (lb/bhp-hr)	PM₁₀ (lb/bhp-hr)	CO (lb/hr)	VOC (lb/hr)	NO_x (lb/hr)	SO_x (lb/hr)	PM₁₀ (lb/hr)
Air Compressor	37	48	0.0110	0.0020	0.0180	0.0020	0.0010	0.195	0.036	0.320	0.036	0.018
Backhoe	79	46.5	0.0150	0.0030	0.0220	0.0020	0.0010	0.551	0.110	0.808	0.073	0.037
Bedding Hopper/Conveyor System	55	46.5	0.0200	0.0030	0.0240	0.0020	0.0015	0.512	0.077	0.614	0.051	0.038
Compactor (sheep-foot)	99	57.5	0.0070	0.0020	0.0200	0.0020	0.0010	0.398	0.114	1.139	0.114	0.057
Concrete Mixer	11	56	0.0100	0.0020	0.0240	0.0020	0.0010	0.062	0.012	0.148	0.012	0.006
Crane	194	43	0.0090	0.0030	0.0230	0.0020	0.0015	0.751	0.250	1.919	0.167	0.125
Dozer	102.9	59	0.0110	0.0020	0.0230	0.0020	0.0010	0.668	0.121	1.396	0.121	0.061
Forklift	83	30	0.0130	0.0030	0.0310	0.0020	0.0015	0.324	0.075	0.772	0.050	0.037
Front End Loader	147	46.5	0.0110	0.0020	0.0230	0.0020	0.0010	0.752	0.137	1.572	0.137	0.068
Gas Welding Machine	19	51	1.4790	0.0540	0.0020	0.0006	0.0003	14.332	0.523	0.019	0.006	0.002
Generator	22	74	0.0110	0.0020	0.0180	0.0020	0.0010	0.179	0.033	0.293	0.033	0.016
Grader	156.6	57.5	0.0080	0.0030	0.0210	0.0020	0.0010	0.720	0.270	1.891	0.180	0.090
Hand Held Vibrator Plate	8	43	2.0400	0.8970	0.0006	0.0005	0.0085	7.018	3.086	0.002	0.002	0.029
Pile Hammer	161	62	0.0200	0.0030	0.0240	0.0020	0.0015	1.996	0.299	2.396	0.200	0.150
Roller	99	57.5	0.0070	0.0020	0.0200	0.0020	0.0010	0.398	0.114	1.139	0.114	0.057
Rubber Tire Loader	147	54	0.0110	0.0020	0.0230	0.0020	0.0015	0.873	0.159	1.826	0.159	0.119
Scraper	266.76	66	0.0110	0.0010	0.0190	0.0020	0.0015	1.937	0.176	3.345	0.352	0.264
Tamping Spade	4	55	2.0400	0.8970	0.0006	0.0005	0.0085	4.488	1.973	0.001	0.001	0.019
Truck Mounted Vertical Auger Drill	209	75	0.0200	0.0030	0.0240	0.0020	0.0015	3.135	0.470	3.762	0.314	0.235
Vibrator Compactor	99	57.5	0.0070	0.0020	0.0200	0.0020	0.0010	0.398	0.114	1.139	0.114	0.057
Well Driller	209	75	0.0200	0.0030	0.0240	0.0020	0.0015	3.135	0.470	3.762	0.314	0.235

Source: South Coast Air Quality Management District CEQA Air Quality Handbook, November 1993, Tables A9-8-B, A9-8-C and A9-8-D

**Table EF-3
Construction Motor Vehicle Exhaust, Tire and Brake Wear, and Entrained Road Dust Emission Factors**

Vehicle Type	Location	Vehicle Class	Speed (mph)	CO		VOC					
				Exhaust (g/mi)	Start-Up ^a (g/start)	Exhaust (g/mi)	Start-Up ^a (g/start)	Hot Soak (g/trip)	Resting (g/hr)	Evap. Running (g/mi)	Diurnal (g/hr)
Worker Commuting	Paved Road	Light Duty Truck	55	3.81	26.10	0.17	3.01	0.51	0.11	0.08	0.58
Worker Bus	Unpaved Road	Urban Bus	35	1.19	0.00	1.38	0.00	0.00	0.00	0.00	0.00
Material Delivery Truck	Paved Road	Heavy Heavy-Duty Truck	55	6.28	0.00	0.78	0.00	0.00	0.00	0.00	0.00
Material Delivery Truck	Unpaved Road	Heavy Heavy-Duty Truck	35	7.10	0.00	1.07	0.00	0.00	0.00	0.00	0.00
Dump Truck	On-Site	Heavy Heavy-Duty Truck	5	33.38	0.00	3.27	0.00	0.00	0.00	0.00	0.00
Pickup Truck	On-Site	Medium-Duty Truck	5	17.25	29.42	1.63	4.14	0.33	0.08	0.08	0.41
Water Truck	On-Site	Heavy Heavy-Duty Truck	5	33.38	0.00	3.27	0.00	0.00	0.00	0.00	0.00

Vehicle Type	Location	NOX		SOX	PM10		
		Exhaust (g/mi)	Start-Up ^a (g/start)	Exhaust (g/mi)	Exhaust (g/mi)	Brake Wear (g/mi)	Tire Wear (g/mi)
Worker Commuting	Paved Road	1.18	2.04	0.00	0.00	0.01	0.01
Worker Bus	Unpaved Road	13.21	0.00	0.08	0.09	0.01	0.03
Material Delivery Truck	Paved Road	11.51	0.00	0.08	0.53	0.01	0.04
Material Delivery Truck	Unpaved Road	8.37	0.00	0.08	0.53	0.01	0.04
Dump Truck	On-Site	15.08	0.00	0.08	0.53	0.01	0.04
Pickup Truck	On-Site	2.08	2.69	0.00	0.00	0.01	0.01
Water Truck	On-Site	15.08	0.00	0.08	0.53	0.01	0.04

Source: ARB EMFAC7G motor vehicle emission factor model, 2/10/2000 version, for calendar year 2001, summertime

^a Based on 720 minutes engine-off