APPENDIX D: TABLES FOR EMISSION REDUCTION

Contents

I. HEAVY DUTY ON-ROAD PROJECTS

Table D-1: Light-Heavy-Duty and Medium-Heavy-Duty Vehicles Emission Factors (EF) (g/mile)[1] and Deterioration Rates (DR) (g/mile-10k miles)

14,001-33,000 pounds (lbs) Gross Vehicle Weight Rating (GVWR) Engine Model Years up to 2012

Engine Model Year	NOx[2] EF[3]	NOx[2] DR[5]	ROG[2],[4] EF[3]	ROG[2],[4] DR[5]	PM[2] EF[3]	PM[2] DR[5]
Pre-1986[6]	15.611	0.0329	1.234	0.070334	0.98973	0.039268
1986-1989[6]	15.388	0.0441	0.969	0.083579	1.07516	0.034997
1990-1992[6]	11.506	0.0577	0.514	0.04367	0.59075	0.026867
1993-1996[6]	11.304	0.0678	0.381	0.050308	0.33587	0.017876
1997-2001[6]	11.115	0.0772	0.388	0.049955	0.36765	0.016222
2002-2005[6]	7.637	0.0765	0.387	0.036274	0.25256	0.009848
2006[6]	6.721	0.0677	0.352	0.028642	0.18869	0.007311
2007	4.811	0.0411	0.258	0.010424	0.02389	0.001178
2007+[7] (0.21-0.50 g/bhp-hr NOx FEL)	1.7	0.0673	0.057	0.002078	0.00441	0.00031
2008	4.739	0.0401	0.255	0.009733	0.01765	0.000946
2009	4.273	0.045	0.219	0.008359	0.01527	0.000832
2010	2.146	0.0673	0.057	0.002078	0.00441	0.00031
2011	1.553	0.0735	0.012	0.000329	0.00139	0.000165
2012	1.546	0.0727	0.012	0.000317	0.00139	0.000159

[1] EMFAC 2021 Zero-Mile Based Emission Factors. Factors are based on diesel engines. Same factors used for alternative fuel engines due to limited alternative fuel data in EMFAC.

[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31.

[3] Emission Factors are based on zero-mile rates contained in EMFAC 2021.

[4] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.

[5] Deterioration Rate per 10,000 miles for engine model years 2012 and older.

[6] PM Factors for 2006 or older engines are for unfiltered trucks.

[7] All model year 2007 and newer engines with Family Emission Limits (FEL) from 0.21 g/bhp-hr to 0.50 g/bhp-hr NOx must use different emission factors from those listed for model years 2010 and newer engines certified to 0.20 g/bhp-hr NOx standards. FEL emission factors are based on EMFAC factors for model year 2010-2012 engines that include weighted averaging of 0.5, 0.35, and 0.20 g/bhphr NOx standards based on sales.

Table D-2: Light-Heavy-Duty and Medium-Heavy-Duty Vehicles Emission Factors (EF) (g/mile)[1] and Deterioration Rates (DR) (g/mile-10k miles)

14,001-33,000 pounds (lbs) Gross Vehicle Weight Rating (GVWR) Emission Factors Engine Model Years 2013 and Newer

Odometer Reading (miles)[10]	Engine Model Year	NOx[2] EF[3]	NOx[2] EmR[7], [8]	ROG[2],[4] EF[3]	ROG[2],[4] DR[5]	PM[2] EF[3]	PM[2] DR[5]
0	2013+ (0.20 g/bhp-hr NOx std)[6]	0.1518	0.1518	0.0055	0.000218	0.00159	0.000061
0	2016+ (0.10 g/bhp-hr NOx std)[8]	0.0759[7]	0.0759	0.0055	0.000218	0.00159	0.000061
0	2016+ (0.05 g/bhp-hr NOx std)[8]	0.03795[7]	0.0380	0.0055	0.000218	0.00159	0.000061
0	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.01518[7]	0.0152	0.0055	0.000218	0.00159	0.000061
0	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.01518[7]	0.0152	0.0055	0.000218	0.00080	0.000061
50,000	2013+ (0.20 g/bhp-hr NOx std)[6]	0.1518	0.4573	0.0055	0.000218	0.00159	0.000061
50,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.0759[7]	0.3526	0.0055	0.000218	0.00159	0.000061
50,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.03795[7]	0.3147	0.0055	0.000218	0.00159	0.000061
50,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.01518[7]	0.2919	0.0055	0.000218	0.00159	0.000061
50,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.01518[7]	0.2919	0.0055	0.000218	0.00080	0.000061
100,000	2013+ (0.20 g/bhp-hr NOx std)[6]	0.1518	0.5455	0.0055	0.000218	0.00159	0.000061
100,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.0759[7]	0.4325	0.0055	0.000218	0.00159	0.000061

Odometer Reading (miles)[10]	Engine Model Year	NOx[2] EF[3]	NOx[2] EmR[7], [8]	ROG[2],[4] EF[3]	ROG[2],[4] DR[5]	PM[2] EF[3]	PM[2] DR[5]
100,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.03795[7]	0.3946	0.0055	0.000218	0.00159	0.000061
100,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.01518[7]	0.3718	0.0055	0.000218	0.00159	0.000061
100,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.01518[7]	0.3718	0.0055	0.000218	0.00080	0.000061
200,000	2013+ (0.20 g/bhp-hr NOx std)[6]	0.1518	0.6591	0.0055	0.000218	0.00159	0.000061
200,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.0759[7]	0.5354	0.0055	0.000218	0.00159	0.000061
200,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.03795[7]	0.4975	0.0055	0.000218	0.00159	0.000061
200,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.01518[7]	0.4747	0.0055	0.000218	0.00159	0.000061
200,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.01518[7]	0.4747	0.0055	0.000218	0.00080	0.000061
400,000	2013+ (0.20 g/bhp-hr NOx std)[6]	0.1518	0.8055	0.0055	0.000218	0.00159	0.000061
400,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.0759[7]	0.6680	0.0055	0.000218	0.00159	0.000061
400,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.03795[7]	0.6301	0.0055	0.000218	0.00159	0.000061
400,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.01518[7]	0.6073	0.0055	0.000218	0.00159	0.000061
400,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.01518[7]	0.6073	0.0055	0.000218	0.00080	0.000061

[1] EMFAC 2021 Zero-Mile Based Emission Factors. Factors are based on diesel engines. Same factors used for alternative fuel engines due to limited alternative fuel data in EMFAC.
[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31
[3] Emission Factors are based on zero-mile rates contained in EMFAC 2021.
[4] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.
[5] Deterioration Rate per 10,000 miles for engine model years 2012 and older.
[6] For engine model year 2013+, NOx deterioration is included and must be calculated through an emission rate formula (grams/mile) power function (results in grams/mile): 0.1518 + 0.1518 x 2.498 x [(odometer^0.3657769215)/(90249^0.3657769215)]. The formula has been simplified in the table.
[7] Factors for 2016+ engines are reduced values of 2013 factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/bhp-hr NOx optional low NOx standards.
[8] Factors for 2016+ engines are reduced values of 2013 factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/nhp-hr NOx optional low NOx standards. NOx emission rate (grams/mile) inclusive of deterioration is calculated by the following power function: NOx EF + 0.9058*0.1518*2.498[(odometer^0.3657769215)/(90249^0.3657769215)].
[9] Factors for 2023+ engines are reduced values of 2016+ PM EF by 50 percent to correspond with 0.0005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year light and medium heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021. Per EMFAC 2021, no change to PM DR from 2016+ for 2023+ engines.
[10] Odometer readings denote the minimum odometer reading needed to use the associated NOx ER. If the odometer reading is less than 50,000 miles, then only the NOx EF would be used for emission reduction calculations.

Table D-3: Heavy-Heavy-Duty Vehicles Emission Factors (EF) (g/mile)[1] and Deterioration Rates (DR) (g/mile-10k miles)

Over 33,000 pounds (lbs) GVWR

Engine Model Year	NOx[2] EF[3]	NOx[2] DR[5]	ROG[2],[4] EF[3]	ROG[2],[4] DR[5]	PM[2] EF[3]	PM[2] DR[5]
Pre-1986[6]	22.980	0.0194	1.9074	0.043474	1.74999	0.027773
1986-1989[6]	22.651	0.0260	1.4980	0.051661	1.90103	0.024752
1990-1992[6]	19.618	0.0394	1.0937	0.037179	0.79736	0.014505
1993-1996[6]	19.274	0.0462	0.8112	0.042831	0.52406	0.011158
1997-2001[6]	18.952	0.0527	0.8262	0.042530	0.57404	0.010132
2002-2005[6]	13.027	0.0522	0.6915	0.025986	0.38682	0.006035
2006[6]	11.465	0.0478	0.6459	0.021163	0.28865	0.004512
2007	8.208	0.0347	0.5416	0.010666	0.03803	0.000901
2007+[7] (0.21-0.50 g/bhp-hr NOx FEL)	2.860	0.0574	0.1200	0.002192	0.00737	0.000262
2008	8.085	0.0342	0.5376	0.010268	0.02853	0.000765
2009	7.290	0.0384	0.4627	0.008819	0.02473	0.000674
2010	3.660	0.0574	0.1200	0.002192	0.00737	0.000262
2011	2.650	0.0627	0.0247	0.000348	0.00254	0.000147
2012	2.654	0.0609	0.0247	0.000334	0.00254	0.000142

[1] EMFAC 2021 Zero-Mile Based Emission Factors. Factors are based on diesel engines. Same factors used for alternative fuel engines due to limited alternative fuel data in EMFAC.

[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31

[3] Emission Factors are based on zero-mile rates contained in EMFAC 2021.

[4] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.

[5] Deterioration Rate per 10,000 miles for engine model years 2012 and older.

[6] PM Factors for 2006 or older engines are for unfiltered trucks.

[7] All model year 2007 and newer engines with Family Emission Limits (FEL) from 0.21 g/bhp-hr to 0.50 g/bhp-hr NOx must use different emission factors from those listed for model years 2010 and newer engines certified to 0.20 g/bhp-hr NOx standards. FEL emission factors are based on EMFAC factors for model year 2010-2012 engines that include weighted averaging of 0.5, 0.35, and 0.20 g/bhp-hr NOx standards based on sales.

Table D-4: Heavy-Heavy-Duty Vehicles Emission Factors (EF) (g/mile)[a], Emission Rates (EmR) (g/mi), and Deterioration Rates (DR) (g/mile-10k miles)
Over 33,000 pounds (lbs) GVWR
Engine Model Years 2013 and Newer

Odometer Reading (miles)[10]	Engine Model Year	NOx[2] EF[3]	NOx[2] EmR[6],[7],[8]	ROG[2] EF[3],[4]	ROG[2],[3] DR[5]	PM[2] EF[3]	PM[2] DR[5]
0	2013-2015 (0.20 g/bhp-hr NOx std)[6]	0.6	0.600	0.0168	0.000150	0.00411	0.000154
0	2016+ (0.20 g/bhp-hr NOx std)[6]	0.6	0.600	0.0136	0.000121	0.00293	0.000110
0	2016+ (0.10 g/bhp-hr NOx std)[8]	0.3[7]	0.300	0.0136	0.000121	0.00293	0.000110
0	2016+ (0.05 g/bhp-hr NOx std)[8]	0.15[7]	0.150	0.0136	0.000121	0.00293	0.000110
0	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.06[7]	0.060	0.0136	0.000121	0.00293	0.000110
0	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.06[7]	0.060	0.0136	0.000121	0.00147	0.000110
50,000	2013-2015 (0.20 g/bhp-hr NOx std)[6]	0.6	1.808	0.0168	0.000150	0.00411	0.000154
50,000	2016+ (0.20 g/bhp-hr NOx std)[6]	0.6	1.808	0.0136	0.000121	0.00293	0.000110

Odometer Reading (miles)[10]	Engine Model Year	NOx[2] EF[3]	NOx[2] EmR[6],[7],[8]	ROG[2] EF[3],[4]	ROG[2],[3] DR[5]	PM[2] EF[3]	PM[2] DR[5]
50,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.3[7]	1.394	0.0136	0.000121	0.00293	0.000110
50,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.15[7]	1.244	0.0136	0.000121	0.00293	0.000110
50,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.06[7]	1.154	0.0136	0.000121	0.00293	0.000110
50,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.06[7]	1.154	0.0136	0.000121	0.00147	0.000110
100,000	2013-2015 (0.20 g/bhp-hr NOx std)[6]	0.6	2.156	0.0168	0.000150	0.00411	0.000154
100,000	2016+ (0.20 g/bhp-hr NOx std)[6]	0.6	2.156	0.0136	0.000121	0.00293	0.000110
100,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.3[7]	1.710	0.0136	0.000121	0.00293	0.000110
100,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.15[7]	1.560	0.0136	0.000121	0.00293	0.000110
100,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.06[7]	1.470	0.0136	0.000121	0.00293	0.000110
100,000	2023+ (0.02 g/bhp-hr NOx std	0.06[7]	1.470	0.0136	0.000121	0.00147	0.000110

Odometer Reading (miles)[10]	Engine Model Year	NOx[2] EF[3]	NOx[2] EmR[6],[7],[8]	ROG[2] EF[3],[4]	ROG[2],[3] DR[5]	PM[2] EF[3]	PM[2] DR[5]
	and 0.005 g/bhp-hr PM std)[8], [9]						
200,000	2013-2015 (0.20 g/bhp-hr NOx std)[6]	0.6	2.605	0.0168	0.000150	0.00411	0.000154
200,000	2016+ (0.20 g/bhp-hr NOx std)[6]	0.6	2.605	0.0136	0.000121	0.00293	0.000110
200,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.3[7]	2.116	0.0136	0.000121	0.00293	0.000110
200,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.15[7]	1.966	0.0136	0.000121	0.00293	0.000110
200,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.06[7]	1.876	0.0136	0.000121	0.00293	0.000110
200,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.06[7]	1.876	0.0136	0.000121	0.00147	0.000110
400,000	2013-2015 (0.20 g/bhp-hr NOx std)[6]	0.6	3.184	0.0168	0.000150	0.00411	0.000154
400,000	2016+ (0.20 g/bhp-hr NOx std)[6]	0.6	3.184	0.0136	0.000121	0.00293	0.000110
400,000	2016+ (0.10 g/bhp-hr NOx std)[8]	0.3[7]	2.640	0.0136	0.000121	0.00293	0.000110

Odometer Reading (miles)[10]	Engine Model Year	NOx[2] EF[3]	NOx[2] EmR[6],[7],[8]	ROG[2] EF[3],[4]	ROG[2],[3] DR[5]	PM[2] EF[3]	PM[2] DR[5]
400,000	2016+ (0.05 g/bhp-hr NOx std)[8]	0.15[7]	2.490	0.0136	0.000121	0.00293	0.000110
400,000	2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[8]	0.06[7]	2.400	0.0136	0.000121	0.00293	0.000110
400,000	2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[8], [9]	0.06[7]	2.400	0.0136	0.000121	0.00147	0.000110

[1] EMFAC 2021 Zero-Mile Based Emission Factors. Factors are based on diesel engines. Same factors used for alternative fuel engines due to limited alternative fuel data in EMFAC.(2)

[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31.

[3] Emission Factors are based on zero-mile rates contained in EMFAC 2021.

[4] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.

[5] Deterioration Rate per 10,000 miles for engine model years 2012 and older.

[6] For engine model year 2013+, NOx deterioration is included and must be calculated through an emission rate formula (grams/mile) power function (results in grams/mile): 0.6 + 0.6 x 2.498 x [(odometer^0.3657769215)/(90249^0.3657769215)]. The formula has been simplified in the table.

[7] Factors for 2016+ engines are reduced values of 2013 factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/nhp-hr NOx standards.

[8] Factors for 2016+ engines are reduced values of 2013 factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/nhp-hr NOx optional low NOx standards. NOx emission rate (grams/mile) inclusive of deterioration is calculated by the following power function: NOx EF + 0.9058*0.6*2.498[(odometer^0.3657769215)/(90249^0.3657769215)].

[9] Factors for 2023+ engines are reduced values of 2016+ PM EF by 50 percent to correspond with 0.0005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year light and medium heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021. Per EMFAC 2021, no change to PM DR from 2016+ for 2023+ engines.

[10] Odometer readings denote the minimum odometer reading needed to use the associated NOx ER. If the odometer reading is less than 50,000 miles, then only the NOx EF would be used for emission reduction calculations.

Table D-5: Diesel Medium Heavy-Duty Urban Buses Emission Factors (EF) (g/mile)[1]

14,001-33,000 pounds (lbs) Gross Vehicle Weight Rating (GVWR) Emission Factors

Engine Model Year	NOx EF [2],[4]	ROG EF [2],[3]	PM EF [2],[4]
Pre-2002	13.768	0.108	0.0896
2002-2005	6.284	0.048	0.0063
2006-2008	3.799	0.236	0.0081
2009+ (0.20 g/bhp-hr NOx std)	0.195	0.040	0.0013
2016+ (0.10 g/bhp-hr NOx std)[5]	0.097	0.040	0.0013
2016+ (0.05 g/bhp-hr NOx std)[5]	0.049	0.040	0.0013
2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[5]	0.019	0.040	0.0013
2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[5],[6]	0.019	0.040	0.0006

[1] EMFAC 2014 Zero-Mile Based Emission Factors.

[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31

[3] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.

[4] Factors for 2006 or older engines are for unfiltered trucks.

[5] Factors for 2016+ engines are reduced values of 2009 NOx emission factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/bhp-hr NOx optional low NOx standards.

[6] Factors for 2023+ engines are reduced values of 2009 PM emission factors by 50 percent to correspond with 0.005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year heavy heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021.

Table D-6: Diesel Heavy Heavy-Duty Urban Buses Emission Factors (EF) (g/mile)[1] over 33,000 pounds (lbs) Gross Vehicle Weight Rating (GVWR)

Engine Model Year	NOx EF [2],[4]	ROG EF [2],[3]	PM EF [2]
Pre-2002[4]	20.266	0.168	0.1584
2002-2005[4]	9.250	0.074	0.0111
2006-2008[4]	6.478	0.503	0.0109
2009+ (0.20 g/bhp-hr NOx std)	0.768	0.099	0.0052
2016+ (0.10 g/bhp-hr NOx std)[5]	0.384	0.099	0.0052
2016+ (0.05 g/bhp-hr NOx std)[5]	0.192	0.099	0.0052
2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[5]	0.077	0.099	0.0052
2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[5],[6]	0.077	0.099	0.0026

[1] EMFAC 2021 Zero-Mile Based Emission Factors.

[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31

[3] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.

[4] Factors for 2006 or older engines are for unfiltered trucks

[5] Factors for 2016+ engines are reduced values of 2009 NOx emission factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/bhp-hr NOx optional low NOx standards.

[6] Factors for 2023+ engines are reduced values of 2009 PM emission factors by 50 percent to correspond with 0.005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year heavy heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021.

Table D-7: Alternative Fuel Medium Heavy-Duty Urban Buses Emission Factors (EF) (g/mile)[1]

14,001-33,000 pounds (lbs) Gross Vehicle Weight Rating (GVWR)

Engine Model Year	NOx EF [2],[4]	ROG EF [2],[3]	PM EF [2]
Pre-2002[4]	8.760	4.134	0.0122
2002-2005[4]	7.979	8.260	0.0085
2006-2016 (0.20 g/bhp-hr NOx std)[4]	0.429	1.695	0.0001
2017+ (0.20 g/bhp-hr NOx std)	0.070	1.214	0.0004
2017+ (0.10 g/bhp-hr NOx std)[5]	0.035	1.214	0.0004
2017+ (0.05 g/bhp-hr NOx std)[5]	0.017	1.214	0.0004
2017+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[5]	0.007	1.214	0.0004
2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[5],[6]	0.007	1.214	0.0002

[1] EMFAC 2021 Zero-Mile Based Emission Factors.
[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter.
[3] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.
[4] Factors for 2006 or older engines are for unfiltered trucks.
[5] These 2010+ emission factors are based only on engines certified to the 0.20 g/bhp-hr NOx standard.
[6] Factors for 2017+ engines are reduced values of 2017+ NOx emission factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/bhp-hr NOx optional low NOx standards.

Table D-8: Alternative Fuel Heavy Heavy-Duty Urban Buses Emission Factors (EF) (g/mile)[1]

over 33,000 pounds (lbs) Gross Vehicle Weight Rating (GVWR)

Engine Model Year	NOx[2],[4] EF	ROG EF[2],[3]	PM EF[2]
Pre-2002[4]	14.937	8.799	0.0191
2002-2005[4]	13.612	17.430	0.0130
2006-2016 (0.20 g/bhp-hr NOx std)[4]	1.443	3.735	0.0004
2017+ (0.20 g/bhp-hr NOx std)	0.234	2.158	0.0007
2017+ (0.10 g/bhp-hr NOx std)[5]	0.117	2.158	0.0007
2017+ (0.05 g/bhp-hr NOx std)[5]	0.059	2.158	0.0007
2017+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[5]	0.023	2.158	0.0007
2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[5],[6]	0.023	2.158	0.00035

[1] EMFAC 2021 Zero-Mile Based Emission Factors.
[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter.
[3] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.
[4] Factors for 2006 or older engines are for unfiltered trucks.
[5] Factors for 2017+ engines are reduced values of 2017+ NOx emission factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/nhp-hr NOx optional low NOx standards.
[6] Factors for 2023+ engines are reduced values of 2009 PM emission factors by 50 percent to correspond with 0.005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year heavy heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021.

Table D-9: Diesel Refuse Trucks Emission Factors (EF) (g/mile)[1]

Engine Model Year	NOx EF [2],[4]	ROG EF [2],[3]	PM EF [2]
Pre-1994[4]	34.69	0.01	0.346
1994-97[4]	31.53	0.01	0.137
1998-02[4]	31.25	0.01	0.144
2003-06[4]	21.39	0.01	0.086
2007-09	11.25	0.14	0.008
2007+ (0.21-0.50 g/bhp-hr NOx FEL)[5]	1.23	0.26	0.008
2010+ (0.20 g/bhp-hr NOx std)[6]	1.09	0.04	0.008
2016+ (0.10 g/bhp-hr NOx std)[7]	0.54	0.04	0.008
2016+ (0.05 g/bhp-hr NOx std)[7]	0.27	0.04	0.008
2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[7]	0.11	0.04	0.008
2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[7],[8]	0.11	0.04	0.004
2026+ (0.01 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[7],[8]	0.055	0.04	0.004

[1] EMFAC 2021 Zero-Mile Based Emission Factors.

[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter. EMFAC 2021 emission factors already account for ultra low-sulfur diesel fuel correction factors as seen in Table D-31.

[3] EMFAC provides HC emission factors which are converted into ROG. ROG = HC * 1.26639.

[4] Factors for 2006 or older engines are for unfiltered trucks.

[5] All model year 2007 and newer engines with Family Emission Limits (FEL) from 0.21 g/bhphr to 0.50 g/bhp-hr NOx must use different emission factors from those listed for model years 2010 and newer engines certified to 0.20 g/bhp-hr NOx standards. FEL emission factors are based on EMFAC factors for model year 2010-2012 engines that include weighted averaging of 0.5, 0.35, and 0.20 g/bhp-hr NOx standards based on sales.

[6] These 2010+ emission factors are based only on engines certified to the 0.20 g/bhp-hr NOx standard.

[7] Factors for 2016+ engines are reduced values of 2010+ NOx emission factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/nhp-hr NOx optional low NOx standards.

[8] Factors for 2023+ engines are reduced values of 2009 PM emission factors by 50 percent to correspond with 0.005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year heavy heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021.

Table D-10: Alternative Fuel Refuse Trucks Emission Factors (EF) (g/mile)[1]

Engine Model Year	NOx EF [2],[4]	ROG EF [2],[3]	PM EF [2]
Pre-2007[4]	53.2	9.86	0.091
2007-09	18.8	3.68	0.004
2010+ (0.20 g/bhp-hr NOx std)	0.88	0.14	0.004
2016+ (0.10 g/bhp-hr NOx std)[5]	0.44	0.14	0.004
2016+ (0.05 g/bhp-hr NOx std)[5]	0.22	0.14	0.004
2016+ (0.02 g/bhp-hr NOx std and 0.01 g/bhp-hr PM std)[5]	0.09	0.14	0.004
2023+ (0.02 g/bhp-hr NOx std and 0.005 g/bhp-hr PM std)[5],[4]	0.09	0.14	0.002

[1] EMFAC 2021 Zero-Mile Based Emission Factors.
[2] NOx – Oxides of nitrogen, ROG – Reactive Organic Gases, PM – Particulate Matter.
[3] EMFAC provides HC emission factors which are converted into ROG. ROG (Pre-2007 engines) = HC * 0.16137. ROG (2007+ engines) = HC * 0.013972.
[4] Factors for 2006 or older engines are for unfiltered trucks.
[5] Factors for 2016+ engines are reduced values of 2010+ NOx emission factors by 50 percent, 75 percent, 90, and 95 percent to correspond with 0.10 g/bhp-hr NOx, 0.05 g/bhp-hr NOx, 0.02 g/bhp-hr NOx, and 0.01 g/nhp-hr NOx optional low NOx standards.
[6] Factors for 2023+ engines are reduced values of 2009 PM emission factors by 50 percent to correspond with 0.005 g/bhp-hr PM standards required exhaust standards for 2024 to 2026 vehicle model year heavy heavy-duty engines per California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles amended September 9, 2021.

II. OFF-ROAD PROJECTS

Table D-11: Off-Road Diesel Engines Default Load Factors (LF)

Category	Equipment Type	Load Factor
Airport Ground Support	Aircraft Tug	0.54
Airport Ground Support	Air Conditioner	0.75
Airport Ground Support	Air Start Unit	0.90
Airport Ground Support	Baggage Tug	0.37
Airport Ground Support	Belt Loader	0.34
Airport Ground Support	Bobtail	0.37
Airport Ground Support	Cargo Loader	0.34
Airport Ground Support	Cargo Tractor	0.36
Airport Ground Support	Forklift	0.20
Airport Ground Support	Ground Power Unit	0.75
Airport Ground Support	Lift	0.34
Airport Ground Support	Passenger Stand	0.40
Airport Ground Support	Service Truck	0.2
Airport Ground Support	Other Ground Support Equipment	0.34
Construction	Air Compressors	0.48
Construction	Bore/Drill Rigs	0.50
Construction	Cement & Mortar Mixers	0.56
Construction	Concrete/Industrial Saws	0.73
Construction	Concrete/Trash Pump	0.74
Construction	Cranes	0.29
Construction	Crawler Tractors	0.43
Construction	Crushing/Process Equipment	0.78
Construction	Excavators	0.38
Construction	Graders	0.41
Construction	Off-Highway Tractors	0.44

Category	Equipment Type	Load Factor
Construction	Off-Highway Trucks	0.38
Construction	Pavers	0.42
Construction	Other Paving	0.36
Construction	Pressure Washer	0.30
Construction	Rollers	0.38
Construction	Rough Terrain Forklifts/ Rubber Tired Dozers	0.40
Construction	Rubber Tired Loaders	0.36
Construction	Scrapers	0.48
Construction	Signal Boards	0.78
Construction	Skid Steer Loaders	0.37
Construction	Surfacing Equipment	0.30
Construction	Tractors/Loaders/Backhoes	0.37
Construction	Trenchers	0.50
Construction	Welders	0.45
Construction	Other Construction Equipment	0.42
Industrial	Aerial Lifts	0.31
Industrial	Forklifts	0.20
Industrial	Sweepers/Scrubbers	0.46
Industrial	Other General Industrial	0.34
Industrial	Other Material Handling	0.40
Forestry	Backhoe	0.54
Forestry	Boom Truck	0.52
Forestry	Carrier	0.52
Forestry	Chipper	0.52
Forestry	Crane	0.54
Forestry	De-limber	0.52
Forestry	Dozer	0.54

Category	Equipment Type	Load Factor
Forestry	Dozer/Skidder	0.52
Forestry	Dozer/Track Skidder	0.52
Forestry	Dump Truck	0.54
Forestry	Excavator	0.54
Forestry	Feller Buncher	0.52
Forestry	Forklift	0.26
Forestry	Forwarder	0.52
Forestry	Front End Loader	0.52
Forestry	Grader	0.54
Forestry	Grinder	0.52
Forestry	Harvester	0.52
Forestry	Heel Boom	0.52
Forestry	Heel Boom Loader	0.52
Forestry	Lift	0.26
Forestry	Loader	0.52
Forestry	Loader/Backhoe	0.54
Forestry	Log Loader	0.52
Forestry	Log Processor	0.52
Forestry	Masticator	0.52
Forestry	P&H Crane	0.54
Forestry	Roller	0.54
Forestry	Rubber Tired Skidder	0.52
Forestry	Skid Steer	0.52
Forestry	Skidder	0.52
Forestry	Straddle Buggy	0.26
Forestry	Stroke De-limber	0.52
Forestry	Sweeper	0.54
Forestry	Sweeper Truck	0.54

Category	Equipment Type	Load Factor
Forestry	Telehandler	0.26
Forestry	Tink Bucket Loader	0.26
Forestry	Truck Mount Loader	0.52
Forestry	Water Tender	0.54
Forestry	Water Truck	0.54
Forestry	Wheel Loader	0.52
Forestry	Yarder	0.52
Oil Drilling	Drill Rig	0.50
Oil Drilling	Lift (Drilling)	0.60
Oil Drilling	Swivel	0.60
Oil Drilling	Workover Rig (Mobile)	0.50
Oil Drilling	Other Workover Equipment	0.60
Cargo Handling	Container Handling Equipment	0.59
Cargo Handling	Cranes	0.20
Cargo Handling	Excavators	0.55
Cargo Handling	Forklifts	0.30
Cargo Handling	Other Cargo Handling Equipment	0.51
Cargo Handling	Sweeper/Scrubber	0.68
Cargo Handling	Tractors/Loaders/Backhoes	0.55
Cargo Handling	Yard Trucks	0.39
Other	All	0.43

Table D-12: Uncontrolled Off-Road Diesel Engines Emission Factors (EF) (g/bhp-hr) and Deterioration Rates (DR) (g/bhp-hr-hr)

Horsepower	Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
0-24	Pre-1988	6.5100	0.0000000	2.0038	0.0002559	0.5396	0.0000000
0-24	1988+	6.5100	0.0000000	1.9284	0.0002464	0.5396	0.0000000
25-49	Pre-1988	6.5100	0.0000977	2.0038	0.0002559	0.5396	0.0000418
25-49	1988+	6.3803	0.0000976	1.9284	0.0002464	0.5148	0.0000399
50-119	Pre-1988	12.0900	0.0002799	1.5682	0.0000725	0.5964	0.0000434
50-119	1988+	7.7209	0.0001783	1.0781	0.0000499	0.5126	0.0000373
120+	Pre-1970	10.2300	0.0001966	0.9975	0.0000395	0.3820	0.0000233
120+	1970-1979	10.2300	0.0001966	0.9975	0.0000395	0.3820	0.0000233
120+	1980-1987	10.2300	0.0001966	0.9730	0.0000385	0.3820	0.0000233
120+	1988+	7.2467	0.0001401	0.7405	0.0000254	0.2726	0.0000133

Table D-13: Controlled Off-Road Diesel Engines Emission Factors (EF) (g/bhp-hr) and Deterioration Rates (DR) (g/bhp-hr-hr)[(1)]

Horsepower	Tier	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
0-24	1	5.1212	0.0000000	1.4026	0.0001825	0.2664	0.0000000
0-24	2	3.9071	0.0000000	0.3086	0.0000646	0.2314	0.0000000
0-24	4 (Final)	3.6754	0.0000000	0.1089	0.0000436	0.1298	0.0000000
25-49	1	4.7854	0.0000888	1.5791	0.0002015	0.2362	0.0000183
25-49	2	4.2185	0.0000824	0.4057	0.0000751	0.1889	0.0000147
25-49	4 (Interim)	4.1968	0.0000874	0.1089	0.0000436	0.1437	0.0000110
25-49	4 (Final)	2.6363	0.0000549	0.1089	0.0000436	0.0210	0.0000023
50-74	1	4.9168	0.0001140	1.0781	0.0000499	0.1989	0.0000145
50-74	2	4.1666	0.0000669	0.3049	0.0000318	0.1409	0.0000103

Horsepower	Tier	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
50-74	3[(2)]	2.7884	0.0000367	0.1089	0.0000272	0.1409	0.0000103
50-74	4 (Interim)	2.7884	0.0000367	0.1089	0.0000272	0.1468	0.0000108
50-74	4 (Final)	2.6132	0.0000343	0.1089	0.0000272	0.0143	0.0000013
75-99	1	5.8850	0.0001363	1.0781	0.0000499	0.2659	0.0000194
75-99	2	4.0499	0.0000651	0.3049	0.0000318	0.1418	0.0000104
75-99	3	2.7179	0.0000357	0.1089	0.0000272	0.1648	0.0000121
75-99	4 (Interim)	2.4825	0.0000327	0.0980	0.0000236	0.1207	0.0000056
75-99	4 (Final)	0.4187	0.0000055	0.0545	0.0000127	0.0332	0.0000015
100-174	1	5.3454	0.0001240	0.7405	0.0000343	0.1259	0.0000092
100-174	2	4.0828	0.0000655	0.2369	0.0000287	0.1126	0.0000081
100-174	3	2.6486	0.0000346	0.1089	0.0000272	0.1257	0.0000090
100-174	4 (Interim)	2.0575	0.0000268	0.0980	0.0000236	0.0609	0.0000028
100-174	4 (Final)	0.2527	0.0000033	0.0545	0.0000127	0.0103	0.0000005
175-299	1	5.3614	0.0001244	0.3485	0.0000161	0.1270	0.0000067
175-299	2	4.3330	0.0000707	0.1634	0.0000246	0.0972	0.0000052
175-299	3	2.7596	0.0000369	0.1133	0.0000270	0.0868	0.0000044
175-299	4 (Interim)	1.4762	0.0000192	0.0762	0.0000199	0.0453	0.0000017
175-299	4 (Final)	0.1717	0.0000023	0.0545	0.0000127	0.0101	0.0000004
300-750	1	5.5375	0.0000921	0.3485	0.0000122	0.1054	0.0000056
300-750	2	4.5226	0.0000645	0.1699	0.0000233	0.0783	0.0000042
300-750	3	2.7447	0.0000356	0.1089	0.0000272	0.0907	0.0000046
300-750	4 (Interim)	1.3879	0.0000181	0.0731	0.0000189	0.0597	0.0000022
300-750	4 (Final)	0.2087	0.0000028	0.0545	0.0000127	0.0128	0.0000005
751+	1	5.4294	0.0000903	0.3485	0.0000122	0.1078	0.0000057
751+	2	3.7726	0.0000524	0.1459	0.0000248	0.0912	0.0000048

Horsepower	Tier	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
751+	4 (Interim)	3.0681	0.0000398	0.1089	0.0000272	0.0767	0.0000036
751+	4 (Final)	1.6251	0.0000210	0.0545	0.0000127	0.0202	0.0000011

Note: Engines participating in the "Tier 4 Early Introduction Incentive for Engine Manufacturers" program per California Code of Regulations, Title 13, section 2423(b)(6) are eligible for funding provided the engines are certified to the final Tier 4 emission standards. The California Air Resources Board (CARB) Executive Order indicates engines certified under this provision. The emission rates for these engines shall be equivalent to the emission factors associated with Tier 3 engines.

Note: For equipment with baseline engines certified under the flexibility provisions per California Code of Regulations, Titles 13, section 2423(d), baseline emission rates shall be determined by using the previous applicable emission standard or Tier for that engine model year and horsepower rating. The CARB Executive Order indicates engines certified under this provision.

(1) Emission factors were converted using the ultra low-sulfur diesel fuel correction factors.
(2) Alternate compliance option.

III. SPARK IGNITION ENGINES

Table D-14: Off-Road LSI Equipment Default Load Factors (LF)

Category	Equipment Type	Load Factor
Airport Ground Support	A/C Tug	0.8
Airport Ground Support	Baggage Tug	0.55
Airport Ground Support	Belt Loader	0.5
Airport Ground Support	Bobtail	0.55
Airport Ground Support	Cargo Loader	0.5
Airport Ground Support	Forklift	0.3
Airport Ground Support	Ground Power Unit	0.75
Airport Ground Support	Lift	0.5
Airport Ground Support	Passenger Stand	0.59
Airport Ground Support	Other Ground Support Equipment	0.5
Construction	Air Compressors	0.56
Construction	Asphalt Pavers	0.66
Construction	Bore/Drill Rigs	0.79
Construction	Concrete/Industrial Saws	0.78
Construction	Concrete/Trash Pump	0.69
Construction	Cranes	0.47
Construction	Gas Compressor	0.85
Construction	Paving Equipment	0.59
Construction	Pressure Washer	0.85
Construction	Rollers	0.62
Construction	Rough Terrain Forklifts	0.63
Construction	Rubber Tired Loaders	0.54
Construction	Skid Steer Loaders	0.58
Construction	Tractors/Loaders/Backhoes	0.48
Construction	Trenchers	0.66
Construction	Welders	0.51
Construction	Other Construction	0.48
Forestry	Shredders	0.80
Industrial	Aerial Lifts	0.46
Industrial	Forklifts	0.3
Industrial	Sweepers/Scrubbers	0.71
Industrial	Other Industrial	0.54

Table D-15a: Off-Road LSI Engines Emission Factors (EF) (g/bhp-hr) and Deterioration Rates (DR) (g/bhp-hr-hr) Gasoline

HP[1]	Type	Engine Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
25.1-50	Uncontrolled	2003 or Older	8.0100	0.0000406	3.3464	0.0003667	0.0600	0.0000000
25.1-50	Controlled	2001-2006	1.3300	0.0004710	0.7171	0.0001707	0.0600	0.0000000
25.1-50	Controlled	2007-2009	0.8867	0.0001190	0.4781	0.0000642	0.0600	0.0000000
25.1-50	Controlled	2010+	0.2660	0.0000250	0.1434	0.0000135	0.0600	0.0000000
50.1-75	Uncontrolled	2003 or Older	9.9250	0.0000504	2.8436	0.0003115	0.0600	0.0000000
50.1-75	Controlled	2001-2006	1.5550	0.0003390	0.4899	0.0001263	0.0600	0.0000000
50.1-75	Controlled	2007-2009	1.0283	0.0000925	0.3047	0.0000695	0.0600	0.0000000
50.1-75	Controlled	2010+	0.3080	0.0000275	0.0869	0.0000138	0.0600	0.0000000
75.1-100	Uncontrolled	2003 or Older	11.8400	0.0000601	2.3407	0.0002554	0.0600	0.0000000
75.1-100	Controlled	2001-2006	1.7800	0.0002070	0.2626	0.0000822	0.0600	0.0000000
75.1-100	Controlled	2007-2009	1.1700	0.0000660	0.1313	0.0000747	0.0600	0.0000000
75.1-100	Controlled	2010+	0.3500	0.0000300	0.0303	0.0000141	0.0600	0.0000000
100.1+	Uncontrolled	2003 or Older	12.9400	0.0001270	1.4329	0.0000369	0.0600	0.0000000
100.1+	Controlled	2001-2006	1.9400	0.0002780	0.1616	0.0001030	0.0600	0.0000000
100.1+	Controlled	2007-2009	1.1700	0.0000660	0.1313	0.0000747	0.0600	0.0000000
100.1+	Controlled	2010+	0.3500	0.0000300	0.0303	0.0000141	0.0600	0.0000000

[1] Horsepower values have been rounded up for simplified presentation. When using this table, please round values up. For example, a value greater than 25 and less than or equal to 50 fits within the 26-50 range.

Table D-15b: Off-Road LSI Engines Emission Factors (EF) (g/bhp-hr) and Deterioration Rates (DR) (g/bhp-hr-hr) Alternative Fuels

HP[1]	Type	Engine Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
25.1-50	Uncontrolled	2003 or Older	13.0000	0.0000662	0.1242	0.0000136	0.0600	0.0000000
25.1-50	Controlled	2001-2006	1.9500	0.0002760	0.0126	0.0000095	0.0600	0.0000000
25.1-50	Controlled	2007-2009	1.3000	0.0000011	0.0084	0.0000155	0.0600	0.0000000
25.1-50	Controlled	2010+	0.3900	0.0000002	0.0025	0.0000033	0.0600	0.0000000
50.1-75	Uncontrolled	2003 or Older	11.7650	0.0000598	0.1319	0.0000144	0.0600	0.0000000
50.1-75	Controlled	2001-2006	1.7650	0.0003130	0.0135	0.0000095	0.0600	0.0000000
50.1-75	Controlled	2007-2009	1.1700	0.0000068	0.0087	0.0000098	0.0600	0.0000000
50.1-75	Controlled	2010+	0.3500	0.0000191	0.0026	0.0000023	0.0600	0.0000000
75.1-100	Uncontrolled	2003 or Older	10.5300	0.0000533	0.1395	0.0000152	0.0600	0.0000000
75.1-100	Controlled	2001-2006	1.5800	0.0003500	0.0144	0.0000093	0.0600	0.0000000
75.1-100	Controlled	2007-2009	1.0400	0.0000125	0.0090	0.0000042	0.0600	0.0000000
75.1-100	Controlled	2010+	0.3100	0.0000380	0.0027	0.0000013	0.0600	0.0000000
100.1+	Uncontrolled	2003 or Older	10.5100	0.0001040	0.1242	0.0000032	0.0600	0.0000000
100.1+	Controlled	2001-2006	1.5800	0.0002640	0.0126	0.0000095	0.0600	0.0000000

HP[1]	Type	Engine Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
100.1+	Controlled	2007-2009	1.0400	0.0000125	0.0090	0.0000042	0.0600	0.0000000
100.1+	Controlled	2010+	0.3100	0.0000380	0.0027	0.0000013	0.0600	0.0000000

[1] Horsepower values have been rounded up for simplified presentation. When using this table, please round values up. For example, a value greater than 25 and less than or equal to 50 fits within the 26-50 range.

Table D-16: Emission Factors (EF) for Off-Road LSI Engine Retrofits Verified to Absolute Emission Number (g/bhp-hr)

Fuel	Verified Value	NOx EF	ROG EF	PM10 EF
Gasoline	3	1.78	0.26	0.06
Gasoline	2.5	1.48	0.22	0.06
Gasoline	2	1.19	0.17	0.06
Gasoline	1.5	0.89	0.13	0.06
Gasoline	1	0.59	0.09	0.06
Gasoline	0.6	0.35	0.03	0.06
Gasoline	0.5	0.29	0.03	0.06
Alt Fuel	3	1.58	0.16	0.06
Alt Fuel	2.5	1.32	0.13	0.06
Alt Fuel	2	1.05	0.11	0.06
Alt Fuel	1.5	0.79	0.08	0.06
Alt Fuel	1	0.53	0.05	0.06
Alt Fuel	0.6	0.31	0.03	0.06
Alt Fuel	0.5	0.26	0.03	0.06

Manufacturers of LSI retrofit systems may verify to a percentage emission reduction or absolute emissions. If a retrofit system is verified to a percentage reduction, the emission factors will be that verified percentage of the appropriate emissions factors in Table D-11a or D-11b. If a retrofit system is verified to an absolute emission number, when calculating emission reductions use the following table for the emission factors and the deterioration rate for the baseline engine.

Table D-17-a: Load Factors (LF) for Off-Road Spark-Ignition 0-25hp

Engine Type	Load Factor
Spark-Ignition 0-25hp	0.40

Table D-17-b: Emission Factors (EF) (g/bhp-hr) for Off-Road Spark Ignition 0-25hp Gasoline

Engine	NOx EF	ROG EF	PM EF
2-Stroke	0.2919	30.6805	0.6500
4-Stroke	1.9047	4.6391	0.0125

Table D-17-c: Emission Factors (EF) (g/bhp-hr) and Deterioration Rates (g/bhp-hr-hr) for Off-Road Spark Ignition 0-25hp Propane

Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM EF	PM DR
1994 or older	1.7700	0.00040	0.3564	0.0003708	0.0900	0.0000937
1995-1998	8.4400	0.00040	1.5600	0.0003708	0.9000	0.0000937
1999 or newer	2.7000	0.00040	0.0450	0.0003708	0.2500	0.0000937

IV. UTILITY TERRAIN VEHICLES

Table D-18: Gasoline Utility Terrain Vehicle (UTV) Load Factors (LF)

Equipment Type	Load Factor
UTVs	0.40

Table D-19: Gasoline Utility Terrain Vehicle (UTV) Emission Factors (g/bhp-hr) (EF) and Deterioration Rates (g/bhp-hr-hr) (DR) Gasoline

Engine	HP	Engine Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM EF	PM DR
2-Stroke	All	All	0.0559	0	196.230	0.0000000	2.3860	0
4-Stroke, Carbureted or Fuel-Injected	All	Pre-1998	3.5799	0	20.598	0.0004183	0.3409	0
4-Stroke, Carbureted	0 – 4.9	1998+	1.7198	0	3.672	0.0004791	0.3409	0
4-Stroke, Fuel-Injected	0 – 4.9	1998+	2.5171	0	1.836	0.0004791	0.3409	0
4-Stroke, Carbureted	5 – 14.9	1998+	2.6682	0	3.902	0.0004791	0.3409	0
4-Stroke, Fuel-Injected	5 – 14.9	1998+	4.1050	0	2.410	0.0004791	0.3409	0
4-Stroke, Carbureted	15 – 24.9	1998+	2.6493	0	4.246	0.0004791	0.3409	0
4-Stroke, Fuel-Injected	15 – 24.9	1998+	4.5975	0	4.705	0.0004791	0.3409	0
4-Stroke, Carbureted	25+	1998+	4.4605	0	4.131	0.0004791	0.3409	0
4-Stroke, Fuel-Injected	25 – 49.9	1998+	4.9064	0	3.098	0.0004791	0.3409	0
4-Stroke, Fuel-Injected	50+	1998+	3.8037	0	3.098	0.0004791	0.3409	0

V. TRANSPORT REFRIGERATION UNITS

Table D-20: Transport Refrigeration Units (TRU) Load Factors (LF)

TRU Category	Below 23 Horsepower	Between 23 and 25 Horsepower: All Years	Over 25 Horsepower: Model Year 2012 and Older	Over 25 Horsepower: Model Year 2013 and Newer
Truck and Trailer TRU	0.56	0.46	0.46	0.38
Generator Sets	-	0.33	0.33	0.27
Railcars	-	0.46	0.46	0.38

Table D-21: Transport Refrigeration Units (TRU) Uncontrolled Emission Factors (g/bhp-hr) (EF) and Deterioration Rates (g/bhp-hr-hr) (DR)

Horsepower	Model Year	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
0-24	Pre-1988	7.0000	0.0000000	2.2264	0.0002844	0.7600	0.0000000
0-24	1988+	7.0000	0.0000000	2.1780	0.0002783	0.7600	0.0000000
25-49	Pre-1988	7.0000	0.0001050	2.2264	0.0002844	0.7600	0.0000589
25-49	1988+	7.0000	0.0001055	2.1780	0.0002783	0.7600	0.0000589

Table D-22: Transport Refrigeration Units (TRU) Controlled Emission Factors (g/bhp-hr) (EF) and Deterioration Rates (g/bhp-hr-hr) (DR)

Horsepower	Tier	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
0-24	1	5.5359	0.0000000	1.7545	0.0002239	0.3846	0.0000000
0-24	2	4.4754	0.0000000	0.3848	0.0000765	0.3029	0.0000000
0-24	4 (Final)	3.8688	0.0000000	0.1210	0.0000484	0.2165	0.0000000
25-49	1	5.1818	0.0000961	1.7545	0.0002239	0.3344	0.0000259
25-49	2	4.5118	0.0000881	0.4507	0.0000835	0.2523	0.0000196

Horsepower	Tier	NOx EF	NOx DR	ROG EF	ROG DR	PM10 EF	PM10 DR
25-49	4 (Interim)	4.4177	0.0000920	0.1210	0.0000484	0.1734	0.0000124
25-49	4 (Final)	2.7751	0.0000578	0.1210	0.0000484	0.0156	0.0000026

VI. LOCOMOTIVES

Table D-23a: Locomotive Emission Factors (EF) (g/bhp-hr) Based on 1998 Federal Standards

Engine Model Year	Type	NOx EF [1]	ROG EF[2]	PM10 EF [1]
Uncontrolled	Line-haul and Passenger	13.00	0.51	0.32
Uncontrolled	Switcher	17.40	1.06	0.44
Tier 0	Line-haul and Passenger	8.60	0.51	0.32
Tier 0	Switcher	12.60	1.06	0.44
Tier 1	Line-haul and Passenger	6.70	0.49	0.32
Tier 1	Switcher	9.90	1.06	0.43
Tier 2	Line-haul and Passenger	4.95	0.27	0.18
Tier 2	Switcher	7.30	0.54	0.19

Note: These factors are to be used for the project baseline emissions if the baseline locomotive is certified or required to be certified to the 1998 federal locomotive remanufacture standards, and for the reduced emission locomotive if the project locomotive is remanufactured to these 1998 standards. Factors are based upon Regulatory Impact Analysis: Final United States Environmental Protection Agency (U.S. EPA) Locomotive Regulation (2008).

[1] NOx and PM10 emission factors have been adjusted by a factor of 0.94 and 0.86, respectively, to account for use of California ultra-low sulfur diesel fuel.

[2] ROG = HC * 1.053

Table D-23b: Locomotive Emission Factors (EF) (g/bhp-hr) Based on 2008 Federal Standards

Engine Model Year	Type	NOx EF [1]	ROG EF[2]	PM10 EF
Tier 0+	Line-haul and Passenger	7.20	0.32	0.20
Tier 0+	Switcher	10.60	0.60	0.23
Tier 1+	Line-haul and Passenger	6.70	0.31	0.20
Tier 1+	Switcher	9.90	0.60	0.23
Tier 2+	Line-haul and Passenger	4.95	0.14	0.08
Tier 2+	Switcher	7.30	0.27	0.11
Tier 3	Line-haul and Passenger	4.95	0.14	0.08
Tier 3	Switcher	4.50	0.27	0.08
Tier 4	Line-haul and Passenger	1.00	0.04	0.015
Tier 4	Switcher	1.00	0.08	0.015

Note: These factors are to be used for the project baseline emissions if the baseline locomotive is certified or required to be certified to the new (2008) federal locomotive remanufacture standards, and for the reduced emission locomotive if the project locomotive is remanufactured to the new standards or meets Tier 3 standards. Factors are based upon Regulatory Impact Analysis: Final U.S. EPA Locomotive Regulation (2008).

[1] NOx and PM10 emission factors have been adjusted by a factor of 0.94 and 0.86, respectively, to account for use of California ultra-low sulfur diesel fuel.

[2] ROG = HC * 1.053

VII. MARINE VESSELS

Table D-24a: Uncontrolled Harbor Craft Propulsion Engine Emission Factors (EF) (g/bhp-hr)

Horsepower	Model Year	NOx EF	ROG EF	PM10 EF
0-24	pre MY 2000	9	1.94	0.9
0-24	MY 2000-2003	4.67	0.21	0.283
25-49	pre MY 2000	8	2.18	0.760
25-49	MY 2000-2003	4.67	0.21	0.283
50-99	pre MY 1988	13	1.74	0.840
50-99	MY 1988 - 1999	8.3	1.20	0.720
50-99	MY 2000 - 2003	5.33	1.20	0.720
100-174	pre MY 1988	12.20	1.26	0.62

Horsepower	Model Year	NOx EF	ROG EF	PM10 EF
100-174	MY 1988 - 1999	9.61	0.79	0.44
100-174	MY 2000-2003	5.62	0.20	0.12
175-799	pre MY 1988	12.2	1.22	0.616
175-799	MY 1988 - 1999	7.34	0.85	0.370
175-799	MY 2000 - 2003	5.62	0.20	0.125
>=800	pre MY 1988	12.2	1.21	0.592
>=800	MY 1988 - 2003	7.34	0.85	0.370

Table D-24b: Controlled Harbor Craft Propulsion Engine Emission Factors (EF) (g/bhp-hr)

Horsepower	Tiers	NOx EF	ROG EF	PM10 EF
0-24	1	4.52	0.21	0.26
0-24	2	4.57	0.21	0.19
0-24	3	4.29	0.20	0.17
25-49	1	4.52	0.21	0.26
25-49	2	4.57	0.21	0.19
25-49	3	4.29	0.20	0.17
50-99	1	4.26	0.20	0.17
50-99	2	4.02	0.18	0.17
50-99	3	3.75	0.18	0.12
100-174	1	5.20	0.21	0.09
100-174	2	4.76	0.22	0.09
100-174	3	3.73	0.16	0.05
175-799	1	5.20	0.21	0.09
175-799	2	4.76	0.22	0.09
175-799	3	3.73	0.16	0.05
>=800	1	6.97	0.22	0.12
>=800	2	5.08	0.22	0.09
>=800	3	3.69	0.20	0.05
>=800	4	1.04	0.04	0.03

Table D-25a: Uncontrolled Harbor Craft Auxiliary Engine Emission Factors (EF) (g/bhp-hr)

Horsepower	Model Year	NOx EF	ROG EF	PM10 EF
0-24	pre MY 2000	9.000	1.936	0.900
0-24	MY 2000-2003	4.667	0.214	0.283
25-49	pre MY 2000	8.000	2.178	0.760
25-49	MY 2000-2003	4.667	0.214	0.283
50-99	pre MY 1988	13.000	1.742	0.840
50-99	MY 1988 - 1999	8.300	1.198	0.720
50-99	MY 2000 - 2003	5.328	1.198	0.720
100-174	pre MY 1988	12.20	1.268	0.62
100-174	MY 1988 - 1999	9.61	0.787	0.440
100-174	MY 2000-2003	5.62	0.200	0.120
175-799	pre MY 1988	12.200	1.21	0.616
175-799	MY 1988 - 1999	7.34	0.847	0.370
175-799	MY 2000 - 2003	5.514	0.200	0.183
>=800	pre MY 1988	12.200	1.210	0.592
>=800	MY 1988 - 2003	7.340	0.847	0.370

Table D-25b: Controlled Harbor Craft Auxiliary Engine Emission Factors (EF) (g/bhp-hr)

Horsepower	Tiers	NOx EF	ROG EF	PM10 EF
0-24	1	4.52	0.21	0.26
0-24	2	4.57	0.21	0.19
0-24	3	4.29	0.20	0.17
25-49	1	4.52	0.21	0.26
25-49	2	4.57	0.21	0.19
25-49	3	4.29	0.20	0.17
50-99	1	4.26	0.20	0.17
50-99	2	4.02	0.18	0.17
50-99	3	3.75	0.18	0.12
100-174	1	4.17	0.17	0.13
100-174	2	3.02	0.15	0.11
100-174	3	3.22	0.14	0.07
175-799	1	4.17	0.17	0.13
175-799	2	3.02	0.15	0.11
175-799	3	3.22	0.14	0.07
>=800	1	6.97	0.18	0.12
>=800	2	5.08	0.22	0.09

Horsepower	Tiers	NOx EF	ROG EF	PM10 EF
>=800	3	3.69	0.20	0.05
>=800	4	1.04	0.04	0.03

Table D-26a: Tier 4 Harbor Craft Engine Emission Standards (g/bhp-hr) for Engines below 800 HP (Not applicable for engines using FEL or ABT for compliance)

Horsepower	Tier	NOx	ROG	PM10
0-799	4	1.34	0.142	0.030

Table D-26b: Harbor Craft Load Factors (LF)

Vessel Type	Main Engine	Auxiliary Engine
Barge - All	-	0.31
Commercial Fishing	0.27	0.44
Commercial Passenger Fishing	0.29	0.45
Crew/Supply	0.26	0.4
Dredge	0.44	0.57
Excursion	0.27	0.4
Ferries - All	0.31	0.39
Pilot Vessels	0.33	0.32
Research Vessels	0.32	0.44
Tugboat-ATB	0.5	0.5
Tugboat-Escort/Ship Assist	0.16	0.34
Tugboat-Push/Tow	0.33	0.37
Workboat	0.33	0.32

Table D-27a: Shore Power NOx Default Emission Factors (EF) (g/kW-hr)

Engine	Type	Uncontrolled	Tier 1	Tier 2	Tier 3
Auxiliary	Medium Speed Diesel (MSD)(1)	10.9	9.8	7.7	2
Auxiliary	High Speed Diesel (HSD)(2)	13.8	12.2	10.5	2.6

(1) A 4-stroke engine with an engine speed range of 500-1400 revolutions per minute (rpm).
(2) A 4-stroke engine with an engine speed range above 1400 revolutions per minute (rpm).

Table D-27b: Shore Power ROG and PM Default Emission Factors (EF) (g/kW-hr)

Engine	Type	ROG	PM
Auxiliary	MSD and HSD	0.484	0.1886

Table D-28 Shore Power Default Power Requirements

Vessel Type	Ship Size / Type Default Twenty-foot Equivalent Unit(1)	Power Requirement (kW)
Auto Carrier(2)	Not Applicable	954

Vessel Type	Ship Size / Type Default Twenty-foot Equivalent Unit[1]	Power Requirement (kW)
Bulk[3]	Not Applicable	522.5
Bulk- Heavy Load[3]	Not Applicable	211
Bulk- Self Discharging[3]	Not Applicable	179
Container	0-1,999	772.5
Container	2,000-2,999	696.5
Container	3,000-3,999	1,052
Container	4,000-4,999	981.5
Container	5,000-5,999	949.5
Container	6,000-6,999	1,090.50
Container	7,000-7,999	934.5
Container	8,000-8,999	1,116.50
Container	9,000-9,999	1,069
Container	10,000-10,999	1,075
Container	11,000-11,999	937.5
Container	12,000-12,999	1,805.50
Container	13,000-13,999	1,267
Container	14,000-14,999	1,218.50
Container	15,000-17,999	1,225
Cruise	0-1,999	3,069
Cruise	2,000-2,499	5,613
Cruise	2,500-2,999	6,900
Cruise	3,000-3,499	6,089
Cruise	3500-3,999	8,292
Cruise	4,000-4,499	10,445
Cruise	4,500-4,999	12,000
Cruise	5,000-5,999	13,000
General Cargo	Not Applicable	808.5
Miscellaneous	Not Applicable	822
Reefer	Not Applicable	1,156
Roll on Roll off (RoRo)	Not Applicable	490
Tanker	Chemical	1,307.50
Tanker	Handysize	903.5
Tanker	Panamax	826
Tanker	Aframax	929.5
Tanker	Suezmax	597
Tanker	VLCC	980
Tanker	ULCC	1,250

[1] These vessels are split into size bins based on the number of passengers they carry.

[2] Auto carrier vessels are designed for exclusive transport of automobiles and trucks. Auto Carriers and RoRo vessels are referred to as separate categories for the purpose of emissions inventory but are considered the same category under "RoRo" for regulatory purposes (as seen in the Control Measures at Berth regulatory text).

[3] The bulk carrier classifications are based on data from Vessel Boarding Program at the Ports of Los Angeles and Long Beach

VIII. LAWN AND GARDEN EQUIPMENT

Table D-29a: Lawn and Garden Equipment Residential Emission Reductions (tons/year-unit)

Residential Equipment	Exhaust ROG	Evaporative ROG	Total ROG	NOx	PM10	Weighted Total
Chainsaws/Trimmers/Edgers/Brushcutters	0.00084290	0.00011059	0.00095349	0.00003331	0.00001010	0.00118873
Leaf blowers/Vacuums	0.00097245	0.00013750	0.00110994	0.00002361	0.00001850	0.00150348
Walk Behind Lawn Mowers	0.00011848	0.00023772	0.00035620	0.00007311	0.00000050	0.00043921
Ride-on or Stand/Sit Mowers	0.00241729	0.00054051	0.00295780	0.00127081	0.00000747	0.00437795

Table D-29b: Lawn and Garden Equipment Commercial Emission Reductions (tons/year-unit)

Commercial Equipment	Exhaust ROG	Evaporative ROG	Total ROG	NOx	PM10	Weighted Total
Chainsaws/Trimmers/ Edgers/ Brushcutters	0.00591650	0.00016751	0.00608400	0.00023147	0.00006986	0.00771271
Leaf blowers/Vacuums	0.01221888	0.00022987	0.01244875	0.00030918	0.00021249	0.01700767
Walk Behind Lawn Mowers	0.00106238	0.00042244	0.00148482	0.00065552	0.00000425	0.00222526

Commercial Equipment	Exhaust ROG	Evaporative ROG	Total ROG	NOx	PM10	Weighted Total
Ride-on or Stand/Sit Mowers	0.00722601	0.00070455	0.00793056	0.00379673	0.00002213	0.01216987

IX. ALL ENGINES

Table D-30: Fuel Consumption Rate Factors(bhp-hr/gal)

Category	Horsepower/Application	Fuel Consumption Rate
Non-Mobile Agricultural Engines	ALL	17.5
Locomotive	Line Haul and Passenger (Class I/II)	20.8
	Line Haul and Passenger (Class III)	18.2
	Switcher	15.2
Other	< 750 hp	18.5
	≥ 750 hp	20.8

Table D-31: Fuel Correction Factors On-Road Diesel Engines

Model Year	NOx	PM10	HC
Pre- 2007	0.93	0.72	0.72
2007+	0.93	0.8	0.72

Table D-32: Fuel Correction Factors Off-Road Diesel Engines

Tier	NOx	PM10	HC
Pre-Tier 1	0.93	0.72	0.72
Tier 1 – Tier 3	0.948	0.8	0.72
Tier 4	0.948	0.852	0.72