

Table 3-4 (Revised 9/6/19)

Emissions from Emergency Equipment

Emissions and fuel use related data provided by the emergency engine manufacturer unless otherwise noted. Emission estimates based on highest absolute hourly emission rate at any engine load. The engines are typically testing weekly for approximately 30 minutes. Daily emission rates assume the engines may be tested for up to 5 hours per day which could occur on an infrequent basis.

EG-1: Caterpillar C32 1000kW Emergency Generator

Number of Units:	1
Engine Rated Hp	1502 Hp
Engine Rated kWm	1120 kW
Max. Fuel Use per Generator	74.34 gal/hr
Max. Daily Operating Hrs. per Generator	5 hrs/day
Max. Annual Operating Hrs. per Generator	100 hr/yr
Max Daily Fuel Use	371.7 gal/day
Max. Annual Fuel Use	7,434.0 gal/yr
ULSD Heating Value	138,000 Btu/gal
Max. Fuel Use	1,026 MMBtu/yr

Criteria Pollutants	Emission Rate (lb/hr)	Potential Emissions (tpy)
NOx	15.97	0.80
CO	1.5	0.075
VOC	0.18	0.0090
PM	0.67	0.0337
SO2	0.018	0.00091

SO2 emission factor from AP-42 Table 3.4-1 and 0.0015% S fuel

PM: See Diesel exhaust particulates emission factor below

Greenhouse Gases (MT/yr)	Emission Factor	Emission Factor Units	Reference	Potential Emissions (tpy)
GHG-CH4	1.04E-05	mtCO2e/gal	(1)	0.085
GHG-CO2	1.02E-02	mtCO2e/gal	(1)	83.6
GHG-N2O	2.47E-05	mtCO2e/gal	(1)	0.20

(1) 40 CFR 98 Tbl. C-1, C-2

mt = Metric Tons

Toxic Air Contaminant	CAS #	Emission Factor	Emission Factor Units	Reference	Potential Emissions (lb/day)	Potential Emissions (lb/yr)
Benzene	71-43-2	0.1863	lb/M gal	(2)	6.92E-02	1.38
1,3-Butadiene	106-99-0	0.2174	lb/M gal	(2)	8.08E-02	1.62
Cadmium and compounds	7440-43-9	0.0015	lb/M gal	(2)	5.58E-04	0.011
Formaldehyde	50-00-0	1.7261	lb/M gal	(2)	6.42E-01	12.83
Chromium VI, chromate and dichromate particulate	1854-02-99	0.0001	lb/M gal	(2)	3.72E-05	0.00074
Arsenic and compounds	7440-38-2	0.0016	lb/M gal	(2)	5.95E-04	0.012
Lead and compounds	7439-92-1	0.0083	lb/M gal	(2)	3.09E-03	0.062
Nickel compounds, insoluble	7440-02-0	0.0039	lb/M gal	(2)	1.45E-03	0.029
Naphthalene	91-20-3	0.0197	lb/M gal	(2)	7.32E-03	0.15
Polycyclic aromatic hydrocarbons (PAHs)		0.0362	lb/M gal	(2)	1.35E-02	0.27
Benzo[a]pyrene	50-32-8	0.0000352	lb/M gal	(2)	1.31E-05	0.00026
Acetaldehyde	75-07-0	0.7833	lb/M gal	(2)	2.91E-01	5.82
Acrolein	107-02-8	0.0339	lb/M gal	(2)	1.26E-02	0.25
Ammonia	7664-41-7	2.9000	lb/M gal	(2)	1.08E+00	21.6
Copper and compounds	7440-50-8	0.0041	lb/M gal	(2)	1.52E-03	0.030
Ethyl benzene	100-41-4	0.0109	lb/M gal	(2)	4.05E-03	0.081
Hexane	110-54-3	0.0269	lb/M gal	(2)	1.00E-02	0.20
Hydrochloric acid	7647-01-0	0.1863	lb/M gal	(2)	6.92E-02	1.38
Manganese and compounds	7439-96-5	0.0031	lb/M gal	(2)	1.15E-03	0.023
Mercury and compounds	7439-97-6	0.0020	lb/M gal	(2)	7.43E-04	0.015
Selenium and compounds	7782-49-2	0.0022	lb/M gal	(2)	8.18E-04	0.016
Toluene	108-88-3	0.1054	lb/M gal	(2)	3.92E-02	0.78
Xylene (mixture), including m-xylene, o-xylene, p-xylene	1330-20-7	0.0424	lb/M gal	(2)	1.58E-02	0.32
Diesel Particulate Matter	N/A	0.67	lb/hr	(3)	3.37E+00	67.39

(2) TAC Emission Factors: ODEQ, email from J.R. Giska, April 24, 2019. The emission factors are from two sources: SCAQMD AB2588 and Ventural APCD AB2588. Benzo[a]pyrene emission factor from AP-42 Table 3.4-4.

(3) Based on the "Tier 2" emission factor of 0.2 g/kWh and the engine operating at 100% load plus the manufacturer supplied hydrocarbon (HC) emission rate used as a conservative estimate of the condensable fraction of DPM. A sample calculation is as follows:

$$\text{Total DPM} = \text{Filterable PM} + \text{Condensable PM (presumed as HCs)}$$

$$(0.2 \text{ g/kW-hr} \times 1120 \text{ kW} / 453.59 \text{ g/lb}) + 0.18 \text{ lb/hr} = 0.67 \text{ lb/hr DPM}$$

Table 3-4 (cont.) (Revised 9/6/19)
Emissions from Emergency Equipment

EG-2: Caterpillar 3516C or equivalent 2000 kW Emergency Generator

Number of Units:	1
Engine Rated Hp	3633 Hp
Engine Rated kWm	2709 kW
Max. Fuel Use per Generator	174 gal/hr
Max. Daily Operating Hrs. per Generator	5 hrs/day
Max. Annual Operating Hrs. per Generator	100 hr/yr
Max Daily Fuel Use	868 gal/day
Max. Annual Fuel Use	17,350 gal/yr
ULSD Heating Value	138,000 Btu/gal
Max. Fuel Use	2,394 MMBtu/yr

Criteria Pollutants	Emission Rate (lb/hr)	Potential Emissions (tpy)
NOx	50.59	2.53
CO	6.01	0.30
VOC	1.20	0.060
PM	2.39	0.120
SO2	0.044	0.0022

SO2 emission factor from AP-42 Table 3.4-1 and 0.0015% S fuel

PM: See Diesel exhaust particulates emission factor below

Greenhouse Gases (MT/yr)	Emission Factor	Emission Factor Units	Reference	Potential Emissions (tpy)
GHG-CH4	1.04E-05	mtCO2e/gal	(1)	0.20
GHG-CO2	1.02E-02	mtCO2e/gal	(1)	195.2
GHG-N2O	2.47E-05	mtCO2e/gal	(1)	0.47

(1) 40 CFR 98 Tbl. C-1, C-2

mt = Metric Tons

Toxic Air Contaminant	CAS #	Emission Factor	Emission Factor Units	Reference	Potential Emissions (lb/day)	Potential Emissions (lb/yr)
Benzene	71-43-2	0.1863	lb/M gal	(2)	1.62E-01	3.23
1,3-Butadiene	106-99-0	0.2174	lb/M gal	(2)	1.89E-01	3.77
Cadmium and compounds	7440-43-9	0.0015	lb/M gal	(2)	1.30E-03	0.03
Formaldehyde	50-00-0	1.7261	lb/M gal	(2)	1.50E+00	29.95
Chromium VI, chromate and dichromate particulate	1854-02-99	0.0001	lb/M gal	(2)	8.68E-05	0.00
Arsenic and compounds	7440-38-2	0.0016	lb/M gal	(2)	1.39E-03	0.03
Lead and compounds	7439-92-1	0.0083	lb/M gal	(2)	7.20E-03	0.14
Nickel compounds, insoluble	7440-02-0	0.0039	lb/M gal	(2)	3.38E-03	0.07
Naphthalene	91-20-3	0.0197	lb/M gal	(2)	1.71E-02	0.34
Polycyclic aromatic hydrocarbons (PAHs)		0.0362	lb/M gal	(2)	3.14E-02	0.63
Benzo[a]pyrene	50-32-8	0.0000352	lb/M gal	(2)	3.06E-05	0.000611
Acetaldehyde	75-07-0	0.7833	lb/M gal	(2)	6.80E-01	13.59
Acrolein	107-02-8	0.0339	lb/M gal	(2)	2.94E-02	0.59
Ammonia	7664-41-7	2.9000	lb/M gal	(2)	2.52E+00	50.32
Copper and compounds	7440-50-8	0.0041	lb/M gal	(2)	3.56E-03	0.07
Ethyl benzene	100-41-4	0.0109	lb/M gal	(2)	9.46E-03	0.19
Hexane	110-54-3	0.0269	lb/M gal	(2)	2.33E-02	0.47
Hydrochloric acid	7647-01-0	0.1863	lb/M gal	(2)	1.62E-01	3.23
Manganese and compounds	7439-96-5	0.0031	lb/M gal	(2)	2.69E-03	0.05
Mercury and compounds	7439-97-6	0.0020	lb/M gal	(2)	1.74E-03	0.03
Selenium and compounds	7782-49-2	0.0022	lb/M gal	(2)	1.91E-03	0.04
Toluene	108-88-3	0.1054	lb/M gal	(2)	9.14E-02	1.83
Xylene (mixture), including m-xylene, o-xylene, p-xylene	1330-20-7	0.0424	lb/M gal	(2)	3.68E-02	0.74
Diesel Particulate Matter	N/A	2.39	lb/hr	(3)	1.20E+01	239.45

(2) TAC Emission Factors: ODEQ, email from J.R. Giska, April 24, 2019. The emission factors are from two sources: SCAQMD AB2588 and Ventural APCD AB2588. Benzo[a]pyrene emission factor from AP-42 Table 3.4-4.

(3) Similar to EG-1 above the emission rate is based on the "Tier 2" emission factor of 0.2 g/kWh and the engine operating at 100% load plus the manufacturer supplied hydrocarbon (HC) emission rate used as a conservative estimate of the condensable fraction of DPM.

Table 3-4 (cont.) (Revised 9/6/19)
Emissions from Emergency Equipment

FWP-1: Clarke JU6H-UFADR8 250 Hp Fire Water Pump Engine

Number of Units:	1
Engine Rated Hp	315 Hp
Engine Rated kWm	235 kW
Max. Fuel Use per Generator	12.30 gal/hr
Max. Daily Operating Hrs. per Generator	5 hr/day
Max. Annual Operating Hrs. per Generator	100 hr/yr
Max Daily Fuel Use	62 gal/day
Max. Annual Fuel Use	1,230.0 gal/yr
ULSD Heating Value	138,000 Btu/gal
Max. Fuel Use	170 MMBtu/yr

Criteria Pollutants *	Emission Rate (lb/hr)	Potential Emissions (tpy)
NOx	2.14	0.11
CO	0.39	0.02
VOC	0.071	0.004
PM	0.161	0.008
SO2	0.0029	0.00014

*Manufacturers emissions data based on laboratory test engine
Manufacturers certificate emissions data multiplied by 1.25 per 40CFR60.4212
SO2 emission factor from AP-42 Table 3.4-1 and 0.0015% S fuel

Greenhouse Gases (MT/yr)	Emission Factor	Emission Factor Units	Reference	Potential Emissions (tpy)
GHG-CH4	1.04E-05	mtCO2e/gal	(1)	0.014
GHG-CO2	1.02E-02	mtCO2e/gal	(1)	13.84
GHG-N2O	2.47E-05	mtCO2e/gal	(1)	0.033

(1) 40 CFR 98 Tbl. C-1, C-2
mt = Metric Tons

Toxic Air Contaminant	CAS #	Emission Factor	Emission Factor Units	Reference	Potential Emissions (lb/day)	Potential Emissions (lb/yr)
Benzene	71-43-2	0.1863	lb/M gal	(2)	1.15E-02	0.23
1,3-Butadiene	106-99-0	0.2174	lb/M gal	(2)	1.34E-02	0.27
Cadmium and compounds	7440-43-9	0.0015	lb/M gal	(2)	9.23E-05	0.00
Formaldehyde	50-00-0	1.7261	lb/M gal	(2)	1.06E-01	2.12
Chromium VI, chromate and dichromate particulate	1854-02-99	0.0001	lb/M gal	(2)	6.15E-06	0.00
Arsenic and compounds	7440-38-2	0.0016	lb/M gal	(2)	9.84E-05	0.00
Lead and compounds	7439-92-1	0.0083	lb/M gal	(2)	5.10E-04	0.01
Nickel compounds, insoluble	7440-02-0	0.0039	lb/M gal	(2)	2.40E-04	0.00
Naphthalene	91-20-3	0.0197	lb/M gal	(2)	1.21E-03	0.02
Polycyclic aromatic hydrocarbons (PAHs)		0.0362	lb/M gal	(2)	2.23E-03	0.04
Benzo[a]pyrene	50-32-8	0.0000352	lb/M gal	(2)	2.17E-06	4.33E-05
Acetaldehyde	75-07-0	0.7833	lb/M gal	(2)	4.82E-02	0.96
Acrolein	107-02-8	0.0339	lb/M gal	(2)	2.08E-03	0.04
Ammonia	7664-41-7	2.9000	lb/M gal	(2)	1.78E-01	3.57
Copper and compounds	7440-50-8	0.0041	lb/M gal	(2)	2.52E-04	0.01
Ethyl benzene	100-41-4	0.0109	lb/M gal	(2)	6.70E-04	0.01
Hexane	110-54-3	0.0269	lb/M gal	(2)	1.65E-03	0.03
Hydrochloric acid	7647-01-0	0.1863	lb/M gal	(2)	1.15E-02	0.23
Manganese and compounds	7439-96-5	0.0031	lb/M gal	(2)	1.91E-04	0.00
Mercury and compounds	7439-97-6	0.0020	lb/M gal	(2)	1.23E-04	0.00
Selenium and compounds	7782-49-2	0.0022	lb/M gal	(2)	1.35E-04	0.00
Toluene	108-88-3	0.1054	lb/M gal	(2)	6.48E-03	0.13
Xylene (mixture), including m-xylene, o-xylene, p-xylene	1330-20-7	0.0424	lb/M gal	(2)	2.61E-03	0.05
Diesel Particulate Matter	N/A	0.16	lb/hr	(3)	8.03E-01	16.06

(2) TAC Emission Factors: ODEQ, email from J.R. Giska, April 24, 2019. The emission factors are from two sources: SCAQMD AB2588 and Ventural APCD AB2588. Benzo[a]pyrene emission factor from AP-42 Table 3.4-4.

(3) Based on an emission factor of 0.2 g/kWh (from TABLE 4 of 40 CFR Part 60 Subpart IIII) and the engine operating at 100% load plus the manufacturer supplied hydrocarbon (HC) emission rate used as a conservative estimate of the condensable fraction of DPM. A sample calculation is as follows:

$$\text{Total DPM} = \text{Filterable PM} + \text{Condensable PM (presumed as HCs)}$$

$$((0.2 \text{ g/kW-hr} + 0.11 \text{ g/kW-hr}) \times 235\text{kW}) / 453.59 \text{ g/lb} = 0.16 \text{ lb/hr DPM}$$