

Marine Emission from Rivertrade vessels

Emission Rate = Engine Power x Loading Factor x Emission Factor

Table 1 - Engine Power used for Calculation

Engine Type	Engine Power by GRT Class (kW) [1,3]			RTV Arrivals by GRT Class [2,3]			Weighted Average Engine Power (kw) [4]
	GRT 0-499	GRT 500-999	GRT ≥ 1000	GRT 0-499	GRT 500-999	GRT ≥ 1000	
Main Engine	232	485	704	2147	54729	14004	521
Auxiliary Engine	66	74	115	2147	54729	14004	82

- Note:
- [1] Engine Power for the Propulsion Engine - Referenced from Table 4-5 of the Study on Marine Vessels Emissions Inventory, HKEPD, February 2012
Engine Power for the Auxiliary Engine - Referenced from Table 4-6 of the Study on Marine Vessels Emissions Inventory, HKEPD, February 2012
- [2] RTV Arrivals - Referenced from Table 4-4 of the Study on Marine Vessels Emissions Inventory, HKEPD, February 2012
- [3] Fully container vessel, conventional cargo vessel and barges were operated in River Trade Terminal.Vessels.
According to 2012 Port of Hong Kong Statistical Tables, the percentage of fully cellular container vessel and conventional cargo vessel accounted for more than 95% of river trade vessels
Since the emission factor of conventional cargo vessel is less than the fully cellular container vessel, all vessels in River Trade Terminal were assumed to be fully cellular container vessel.
- [4] Weighted Average Engine Power = Σ (Engine Power by GRT Class x RTV Arrivals by GRT Class) / Σ (RTV Arrivals by GRT Class)

Table 2 - Engine Loading Factor and Emission Factor

Engine Type	Engine Power	Loading Factor [5]		Emission Factor (g/kWh) [6]					
	(kW)	Maneuvering	Hotelling	SO2	Nox	PM10	PM2.5	VOC	CO
Main Engine	521	0.30	0.00	2.08	10.00	0.30	0.29	0.27	1.50
Auxiliary Engine	82	0.50	0.17	2.08	10.00	0.40	0.39	0.27	1.70

- Note:
- [5] Loading Factor for the Propulsion Engine - Referenced from Table 4-7 of the Study on Marine Vessels Emissions Inventory, HKEPD, February 2012
Loading Factor for the Auxiliary Engine - Referenced from Table 2-8 of the Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories, USEPA, April 2009
- [6] Emission Factor for the Propulsion Engine & Auxiliary Engine - Referenced from Table 4-16 of the Study on Marine Vessels Emissions Inventory, HKEPD, February 2012. For main engines, emission factor for Cat. 1 is adopted.

Table 3a - Emission Rate (Maneuvering) per vessel

Pollutant	Emission Rate (kg/hr)			Emission Rate for 10 minutes within an hour [7]
	Main Engine	Auxiliary Engine	Total	(g/s)
SO2	0.32	0.09	0.41	0.0190
NOx	1.56	0.41	1.97	0.0913
PM10	0.05	0.02	0.06	0.0029
PM2.5	0.05	0.02	0.06	0.0028
VOC	0.04	0.01	0.05	0.0025
CO	0.23	0.07	0.30	0.0141

- Note
- [7]: Maneuvering Time (10 Minutes) based on information provided by the operator

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Table 3b - Emission Rate (Hotelling) per vessel

Pollutant	Emission Rate (kg/hr)			Emission Rate (g/s) [8]	Emission Rate at 49 berths (g/s) [9]
	Main Engine	Auxiliary Engine	Total		
SO2	0.00	0.03	0.03	0.0201	0.0004
NOx	0.00	0.14	0.14	0.0966	0.0020
PM10	0.00	0.01	0.01	0.0039	0.0001
PM2.5	0.00	0.01	0.01	0.0038	0.0001
VOC	0.00	0.00	0.00	0.0026	0.0001
CO	0.00	0.02	0.02	0.0164	0.0003

Note:

[8] Hotelling Time for each vessel assumed to be 2.5 hours (based on informtation provided by operator

[9] Emission is assumed to be evenly distributed among berths at River Trade Terminal

On Shore Emission at River Trade Terminal

Emission Rate = Equipment Power x Emission Factor

Table 1 - Crane Fuel Consumption, Power, and Emission Factors

Equipment Type	Fuel Consumption (L/hr) [1]	Fuel Consumption (gallon/hr) [2]	Power (hp) [3]	Power (kW) [4]	Emission Factor (g/kWh) [5]					
					SO2	Nox	PM10	PM2.5	VOC	CO
Container handler	18	4.76	82.3	61.4	0.022	0.400	0.020	0.019	0.190	3.500
Container RTG crane	24	6.34	109.8	81.9	0.022	0.400	0.020	0.019	0.190	3.500

- Note:
- [1] Fuel consumption information provided by operator
- [2] 1 gallon = 3.78541 L
- [3] Power (hp) = Fuel Consumption (gallon/hr) * 7.1 (lb/gallon) / 0.41 (lb/hp-hr) (Referenced from Equation 4 of Rubber Tired Gantry Crane Load Factor Study, Port of Los Angeles, November 2009)
- [4] 1 hp = 0.7457 kW
- [5] Emission Factor for the Cranes are based on USEPA Tier 4 Non-Road Emission Standards

Table 2 - Emission Rate per Barge (Moveable Cranes)

Pollutant	Emission Rate (kg/hr)			Emission Rate per Vessel (kg/hr) [6,7]	Emission Rate per Vessel (g/s)
	Container handler	Container RTG Crane	Total		
SO2	0.0014	0.0018	0.0032	0.0040	0.0011
NOx	0.0246	0.0327	0.0573	0.0716	0.0199
PM10	0.0012	0.0016	0.0029	0.0036	0.0010
PM2.5	0.0012	0.0016	0.0028	0.0035	0.0010
VOC	0.0117	0.0156	0.0272	0.0340	0.0095
CO	0.2149	0.2866	0.5015	0.6268	0.1741

- Note
- [6]: Each vessel is assumed to be docked for 2.5 hours (based on information provided by operator)
- [7]: Utilization rate of cranes is 50%--operating time is 1.25 hours / vessel (Based on information provided by operator)