

Table 1. MARPOL Annex VI NOx Emission Limits

Tier	Date	NOx Limit, g/kWh		
		n < 130	130 ≤ n < 2000	n ≥ 2000
Tier I	2000	17.0	45 · n ^{-0.2}	9.8
Tier II	2011	14.4	44 · n ^{-0.22}	7.7
Tier III	2016†	3.4	9 · n ^{-0.2}	3.96

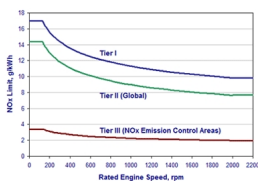
† In NOx Emission Control Areas (Tier II standards apply outside ECAs).

NOx emission limits are set for diesel engines depending on the engine maximum operating speed (n, rpm), as shown in Table 1 and presented graphically in Figure 1. Tier I and Tier II limits are global, while the Tier III standards apply only in NOx Emission Control Areas.

Tier II standards are expected to be met by combustion process optimization. The parameters examined by engine manufacturers include fuel injection timing, pressure, and rate (rate shaping), fuel nozzle flow area, exhaust valve timing, and cylinder compression volume.

Tier III standards are expected to require dedicated NOx emission control technologies such as various forms of water induction into the combustion process (with fuel, scavenging air, or in-cylinder), exhaust gas recirculation, or selective catalytic reduction.

Figure 1. MARPOL Annex VI NOx Emission Limits



Pre-2000 Engines. Under the 2008 Annex VI amendments, Tier I standards become applicable to existing engines installed on ships built between 1st January 1990 to 31st December 1999, with a displacement ≥ 90 liters per cylinder and rated output ≥ 5000 kW, subject to availability of approved engine upgrade kit. Testing. Engine emissions are tested on various ISO 8178 cycles (E2, E3 cycles for various types of propulsion engines, D2 for constant speed auxiliary engines, C1 for variable speed and load auxiliary engines).

Addition of not-to-exceed (NTE) testing requirements to the Tier III standards is being debated. NTE limits with a multiplier of 1.5 would be applicable to NOx emissions at any individual load point in the E2/E3 cycle.

Engines are tested using distillate diesel fuels, even though residual fuels are usually used in real life operation.

Further technical details pertaining to NOx emissions, such as emission control methods, are included in the mandatory “NOx Technical Code”, which has been adopted under the cover of “Resolution 2”.

- If we can help you with a tailor made solution to fulfill your demands in emission reduction, please [contact us](#) . Also for any questions regarding this subject we are glad to answer you as good as possible. [Contact us](#)



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