

GLOBAL EMISSIONS STANDARDS

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1. ON-ROAD



EUROPE | ON-ROAD

Euro I | Euro II | Euro III | Euro IV | Euro V | Euro VI | Euro VII

EU emission standards for heavy-duty CI (diesel) engines: Steady-state testing											
Stage	Date	Test	CO	HC	CH ₄	NO _x	NH ₃	N ₂ O	PM	PN	Smoke
			g/kWh								1/kWh
Euro I	1992, ≤ 85 kW	ECE R-49	4.5	1.1	-	8	-	-	0.612	-	-
	1992, > 85 kW		4.5	1.1	-	8	-	-	0.36	-	-
Euro II	1996.1		4	1.1	-	7	-	-	0.25	-	-
	1998.1		4	1.1	-	7	-	-	0.15	-	-
Euro III	1999.10 EEV only	ESC & ELR	1.5	0.25	-	2	-	-	0.02	-	0.15
	2000.1		2.1	0.66	-	5	-	-	0.10 ^a	-	0.8
Euro IV	2005.1		1.5	0.46	-	3.5	-	-	0.02	-	0.5
Euro V	2008.1	1.5	0.46	-	2	-	-	0.02	-	0.5	
Euro VI	2013.01	WHSC	1.5	0.13	-	0.4	10 ppm	-	0.01	8.0×10 ^{11b}	-
Euro VII	2028.05.29		1.5	0.080 ^d	0.5	0.2	0.06	0.2	0.008	6.0×10 ^{11c}	-

a PM = 0.13 g/kWh for engines < 0.75 dm³ swept volume per cylinder and a rated power speed > 3000 min⁻¹
 b PN₂₃
 c PN₁₀
 d NMOG

EU emission standards for heavy-duty CI (diesel) and PI engines: Transient testing										
Stage	Date	Test	CO	NMHC	CH _{4a}	NO _x	NH ₃	N ₂ O	PM ^b	PN
			g/kWh							
Euro III	1999.10 EEV only	ETC	3	0.4	0.65	2	-	-	0.02	-
	2000.1		5.45	0.78	1.6	5	-	-	0.16 ^c	-
Euro IV	2005.1		4	0.55	1.1	3.5	-	-	0.03	-
Euro V	2008.1		4	0.55	1.1	2	-	-	0.03	-
Euro VI	2013.01	WHTC	4	0.16 ^d	0.5	0.46	10 ppm	-	0.01	6.0×10 ^{11e}
Euro VII	2028.05.29		1.5	0.080 ^g	0.5	0.2	0.06	0.2	0.008	6.0×10 ^{11f}

a Euro III-V: NG only; Euro VI: NG + LPG; Euro VII: all engines
 b not applicable for gas fueled engines at the Euro III-IV stages
 c PM = 0.21 g/kWh for engines < 0.75 dm³ swept volume per cylinder and a rated power speed > 3000 min⁻¹
 d THC for diesel (CI) engines
 e PN₂₃. PN limit for PI engines applies for Euro VI-B and later ^[4374]
 f PN₁₀
 g NMOG

EU emission standards for heavy-duty CI (diesel) and PI engines: RDE testing									
Stage	Date	Test	CO	NMHC	CH _{4a}	NO _x	NH ₃	N ₂ O	PN ₁₀
			g/kWh						
Euro VII	2028.05.29	RDE	1.950	0.105	0.650	0.260	0.085	0.260	9.0×10 ¹¹



CHINA | ON-ROAD

China I | China II | China III | China IV | China V | China VI-a | China VI-b

Emission standards implementation dates		
Stage	Nationwide	
	Type Approval	All Vehicles
China I	2000.09	2001.09
China II	2003.09	2004.01
China III	2007.01	2008.01
China IV	2010.01	2015.01
China V	-	2016.04 ^{b,c} 2017.01 ^c 2017.07 ^a
China VI-a	-	2019.07
	-	2021.07 ^d
China VI-b	-	2021.07
	-	2023.07

a All vehicles
 b Beijing, Shanghai, Tianjin, Hebei, Liaoning, Jiangsu, Zhejiang, Fujian, Shandong and Guangzhou
 c Public transportation buses, sanitary and postal vehicles
 d 2020.07 for urban HDVs

China III-V emission standards for heavy-duty engines									
Stage	Test Cycle	CO	HC	NMHC	NO _x	PM	NH ₃	Smoke	
		g/kWh					ppm	1/m	
China III	ESC + ELR	2.1	0.66	-	5.0	0.10 ^a	-	0.8	
	ETC	5.45	-	0.78	5.0	0.16 ^a	-	-	
China IV	ESC + ELR	1.5	0.46	-	3.5	0.02	-	0.5	
	ETC	4.0	-	0.55	3.5	0.03	-	-	
China V	ESC + ELR	1.5	0.46	-	2.0	0.02	10 ^b	0.5	
	ETC	4.0	-	0.55	2.0	0.03	10 ^b	-	
Stage	Test Cycle	CO	HC	NMHC	CH ₄	NO _x	PM	PN	NH ₃
		Mg/kWh						kWh-1	ppm
China VI CI	WHSC	1500	130	-	-	400	10	8.0×10 ¹¹	10
	WHTC	4000	160	-	-	460	10	6.0×10 ¹¹	10
	WNTE	2000	220	-	-	600	16	-	-
China VI PI	WNTE	4000	-	160	500	460	10	6.0×10 ¹¹	10
	WNTE	2000	220	-	-	600	13	-	-

a 0.13/0.21 (ESC/ETC) for engines < 0.75 L per cylinder and rated speed > 3000 rpm
 b Cycle average; 25 ppm maximum



INDIA | ON-ROAD

India 2000 | BS II | BS III | BS IV | BS V | BS VI

Emission standards for heavy-duty engines									
Stage	Year	Test	CO	HC	CH ₄	NO _x	PM	PN	NH ₃
			g/kWh					kWh ⁻¹	ppm
	1992	ECE R49	17.3	2.7	-	-	-	-	-
	1996	ECE R49	11.2	2.4	-	14.4	-	-	-
India 2000	2000	ECE R49	4.5	1.1	-	8.0	0.36 ^a	-	-
BS II	2005 †	ECE R49	4.0	1.1	-	7.0	0.15	-	-
BS III	2010 †	ESC	2.1	0.66	-	5.0	0.10	-	-
		ETC	5.45	0.78	-	5.0	0.16	-	-
BS IV	2010 ‡	ESC	1.5	0.46	-	3.5	0.02	-	-
		ETC	4.0	0.55	-	3.5	0.03	-	-
BS V	n/a ^b	ESC	1.5	0.46	-	2.0	0.02	-	-
		ETC	4.0	0.55	1.1 ^d	2.0	0.03	-	-
BS VI	2020 ^c	WHSC (CI)	1.5	0.13	-	0.40	0.01	8.0×10 ¹¹	10
		WHTC (CI)	4.0	0.16	-	0.46	0.01	6.0×10 ¹¹	10
		WHTC (PI)	4.0	0.16 ^f	0.50	0.46	0.01	6.0×10 ¹¹	10

† earlier introduction in selected regions, see India: Table 1
 ‡ only in selected regions, see India: Table 1
 a 0.612 for engines below 85 kW
 b Initially proposed in 2015.11 [3297][3298] but removed from a 2016.02 proposal [3349]
 c For CNG engines only
 d NMHC for PI engines



SINGAPORE | ON-ROAD

Euro I | Euro II | Euro III | Euro IV | Euro V | Euro VI | Japan 2009

Emission requirements for new light-duty vehicles	
Date	Requirement
Diesel Vehicles	
1998.07	Euro I (Directive 93/59/EEC)
2001.01	Euro II (Directive 96/69/EC)
2014.01	Euro V (Regulation (EC) 715/2007) or Japan 2009 standards
2018.01	Euro VI (Regulation (EC) 715/2007) or Japan 2009 plus Euro 6 PN limit

Emission requirements for new heavy-duty diesel engines	
Date	Requirement
1998.07	Euro I (Directive 91/542/EEC Stage I)
2001.01	Euro II (Directive 91/542/EEC Stage II)
2006.10	Euro II (Directive 91/542/EEC Stage II)
2014.1	Euro IV (Directive 1999/96/EC-B1(2005))
2018.01	Euro VI (Regulation (EC) 595/2009 and (EU) 582/2011) or Japan 2009 plus Euro VI PN limit

Japan 2009					
Date	Test	CO	HC	NOx	PM
		<i>Mean(max)</i>	<i>Mean(max)</i>	<i>Mean(max)</i>	<i>Mean(max)</i>
2009	JE05	16.0	0.23d	0.7	0.01a

a - PM values apply only to direct-injection, lean-burn vehicles equipped with absorption-type NOx reduction catalysts.



SOUTH KOREA | ON-ROAD

Euro III | Euro IV | Euro V | Euro VI

Emission Standards for Heavy-Duty Diesel Engines							
Date	Test	CO	HC	NOx	PM	PN	Reference
		g/kWh					
1993.01	6-mode	980†	670†	350† IDI 750† DI	-	-	-
1996.01	13-mode	4.90	1.20	11.0	0.90	-	-
1998.01	13-mode	4.90	1.20	6.0 (9.0)*	0.25 (0.50)*	-	-
2000.01	13-mode	4.90	1.20	6.0	0.25 (0.10)*	-	-
2002.01	13-mode	4.90	1.20	6.0	0.15 (0.10)*	-	-
2003.01	ESC	2.1	0.66	5.0	0.10	-	Euro III
	ETC	5.45	0.78	5.0	0.16	-	
2006.01	ESC	1.5	0.46	3.5	0.02	-	Euro IV
	ETC	4.0	0.55	3.5	0.03	-	
2009.09	ESC	1.5	0.46	2.0	0.02	-	Euro V
	ETC	4.0	0.55	2.0	0.03	-	
2014.01	WHSC	1.5	0.13	0.40	0.01	8.0×10 ¹¹	Euro VI
	WHTC	4.0	0.16	0.46	0.01	6.0×10 ¹¹	

* applies to buses | † JP 6-mode test, limits expressed in ppm


UNITED STATES | ON-ROAD

EPA | CARB

US EPA & California emission standards for heavy-duty CI engines, FTP, g/bhp-hr						
Year	CO	HC ^a	HC ^{a+} NO _x	NO _x	PM	
					General	Urban Bus
1974	40	-	16	-	-	
1979	25	1.5	10	-	-	
1985	15.5	1.3	-	10.7	-	
1988	15.5	1.3 ^c	-	10.7 ^d	0.60	
1990	15.5	1.3 ^c	-	6.0	0.60	
1991	15.5	1.3 ^c	-	5.0	0.25	0.25 ^f
1993	15.5	1.3 ^c	-	5.0	0.25	0.10
1994	15.5	1.3 ^c	-	5.0	0.10	0.07
1996	15.5	1.3 ^c	-	5.0 ^e	0.10	0.05 ^g
1998	15.5	1.3	-	4.0	0.10	0.05 ^g
2004 ⁱ	15.5	-	2.4 ^h	-	0.10	0.05 ^g
2007	15.5	0.14 ^j	-	0.20 ^j	0.01	
2024 ^k	15.5	0.14	-	0.05	0.005	
2027 ^k	15.5	0.14	-	0.02	0.005	
2027	6.0	0.06	-	0.035 ^l	0.005	

a) NMHC for 2004 and later standards
 b) For methanol-fueled engines, the standard is for total hydrocarbon equivalent (THCE).
 c) California: NMHC = 1.2 g/bhp-hr, in addition to the THC limit.
 d) California: NO_x = 6.0 g/bhp-hr
 e) California: Urban bus NO_x = 4.0 g/bhp-hr
 f) California standard 0.10 g/bhp-hr
 g) In-use PM standard 0.07 g/bhp-hr
 h) Alternative standard: NMHC+NO_x = 2.5 g/bhp-hr and NMHC = 0.5 g/bhp-hr
 i) Under the 1998 Consent Decrees, several manufacturers supplied 2004 compliant engines from October 2002.
 j) NO_x and NMHC standards were phased-in on a percent-of-sales basis: 50% in 2007-2009 and 100% in 2010. Most manufacturers certified their 2007-2009 engines to a NO_x limit of about 1.2 g/bhp-hr, based on a fleet average calculation.
 k) California only, not applicable at the federal level.
 l) A NO_x compliance allowance of 0.015 g/bhp-hr is added to the standard for any in-use testing of Medium HDE and Heavy HDE

2. NON-ROAD



EUROPE | NON-ROAD

Stage I | Stage II | Stage III A | Stage III B | Stage IV | Stage V

EU Stage I/II emission standards for nonroad diesel engines							
Cat.	Net Power	Date*	CO	HC	HC+NO _x	NO _x	PM
	kW						
Stage I							
A	130 ≤ P ≤ 560	1999.01	5.0	1.3	-	9.2	0.54
B	75 ≤ P < 130	1999.01	5.0	1.3	-	9.2	0.70
C	37 ≤ P < 75	1999.04	6.5	1.3	-	9.2	0.85
Stage II							
E	130 ≤ P ≤ 560	2002.01	3.5	1.0	-	6.0	0.2
F	75 ≤ P < 130	2003.01	5.0	1.0	-	6.0	0.3
G	37 ≤ P < 75	2004.01	5.0	1.3	-	7.0	0.4
D	18 ≤ P < 37	2001.01	5.5	1.5	-	8.0	0.8
Stage III A							
H	130 ≤ P ≤ 560	2006.01	3.5	-	4.0	-	0.2
I	75 ≤ P < 130	2007.01	5.0	-	4.0	-	0.3
J	37 ≤ P < 75	2008.01	5.0	-	4.7	-	0.4
K	19 ≤ P < 37	2007.01	5.5	-	7.5	-	0.6
Stage III B							
L	130 ≤ P ≤ 560	2011.01	3.5	0.19	-	2.0	0.025
M	75 ≤ P < 130	2012.01	5.0	0.19	-	3.3	0.025
N	56 ≤ P < 75	2012.01	5.0	0.19	-	3.3	0.025
P	37 ≤ P < 56	2013.01	5.0	-	4.7	-	0.025
Stage IV							
Q	130 ≤ P ≤ 560	2014.01	3.5	0.19	-	0.4	0.025
R	56 ≤ P < 130	2014.01	5.0	0.19	-	0.4	0.025
* Stage II also applies to constant speed engines effective 2007.01 † Dates for constant speed engines are: 2011.01 for categories H, I and K; 2012.01 for category J.							

Stage V emission standards for nonroad engines (NRE)								
Category	Ign.	Net Power	Date†	CO	HC	NO _x	PM	PN
		kW						
NRE-v/c-1	CI	P < 8	2019	8.00	7.50 ^{a,c}		0.40 ^b	-
NRE-v/c-2	CI	8 ≤ P < 19	2019	6.60	7.50 ^{a,c}		0.40	-
NRE-v/c-3	CI	19 ≤ P < 37	2019	5.00	4.70 ^{a,c}		0.015	1×10 ⁻¹²
NRE-v/c-4	CI	37 ≤ P < 56	2019	5.00	4.70 ^{a,c}		0.015	1×10 ⁻¹²
NRE-v/c-5	All	56 ≤ P < 130	2020	5.00	0.19 ^c	0.40	0.015	1×10 ⁻¹²
NRE-v/c-6	All	130 ≤ P ≤ 560	2019	3.50	0.19 ^c	0.40	0.015	1×10 ⁻¹²
NRE-v/c-7	All	P > 560	2019	3.50	0.19 ^d	3.50	0.045	-
a HC+NO _x b 0.60 for hand-startable, air-cooled direct injection engines c A = 1.10 for gas engines d A = 6.00 for gas engines † Including constant speed engines								

Stage V emission standards for nonroad engines (NRE)								
Category	Ign.	Net Power	Date	CO	HC	NO _x	PM	PN
		<i>kW</i>		<i>g/kWh</i>				
NRG-v/c-1	All	P > 560	2019	3.50	0.19 ^a	0.67	0.035	-

MCP emission standards for liquid fueled engines					
Fuel Type	Category	Power	NO _x +HC	PM	Power
		<i>MW_{th}</i>	<i>mg/Nm³</i>		
Diesel (gas oil)	Existing engines	1 ≤ P ≤ 5	250a	-	
		5 < P < 50	190a	-	-
	New engines	1 ≤ P < 50	190b	-	-
Other liquid fuels	Existing engines	1 ≤ P ≤ 5	250a	20	120
		5 < P ≤ 20	225a	20	120
		20 < P < 50	190a	10	120
	New engines	1 ≤ P ≤ 5	190b,c	20d	120e
		5 < P < 50	190b,c	10d	120e

a 1850 mg/Nm³ for (1) diesel engines the construction of which commenced before 18 May 2006 and (2) dual-fuel engines in liquid mode
b 225 mg/Nm³ for dual fuel engines in liquid mode.
c 225 mg/Nm³ for engines with a total rated thermal input ≤ 20 MW with ≤ 1200 rpm
d 75 mg/Nm³ until 1 January 2025 for engines which are part of small (SIS) or micro isolated (MIS) networks
e 590 mg/Nm³ until 1 January 2025 for engines which are part of small (SIS) or micro isolated (MIS) networks



EUROPE | NON-ROAD - RAIL

Stage III A | Stage III B | Stage V

Stage III A/B emission standards for rail traction engines							
Category	Net Power	Date	CO	HC	HC+NO _x	NO _x	PM
	<i>kW</i>		<i>g/kWh</i>				
Stage III A							
RC A	P > 130	2006	3.5	-	4.0	-	0.2
RL A	130 ≤ P ≤ 560	2007	3.5	-	4.0	-	0.2
RH A	P > 560	2009	3.5	0.5*	-	6.0*	0.2
Stage III B							
RC B	P > 130	2012	3.5	0.19	-	2.0	0.025
R B	P > 130	2012	3.5	-	4.0	-	0.025

* HC = 0.4 g/kWh and NO_x = 7.4 g/kWh for engines of P > 2000 kW and D > 5 litres/cylinder

Stage V emission standards for rail traction engines							
Category	Net Power	Date	CO	HC ^a	NO _x	PM	PN
	<i>kW</i>		<i>g/kWh</i>				
RLL-v/c-1 (Locomotives)	P > 0	2021	3.50	4.00 ^b		0.025	-
RLR-v/c-1 (Railcars)	P > 0	2021	3.50	0.19	2.00	0.015	1×10 ¹²

a A = 6.00 for gas engines
b HC + NO_x



GERMANY | NON-ROAD

 TA Luft 2002 | 44th BImSchV

TA Luft 2002 and 44th BImSchV emission limits for new and existing gaseous fueled engines																		
TAL = TA Luft 2002; BIm = 44th BImSchV; Values expressed as concentration at 5% O ₂																		
Gaseous Fuel	Engine Type		Power		CO ^e		NO _x ^e		SO _x ^{a,e}		HCHO		TD ^a		TC ^e		NH ₃ ^d	
			MW _{th}		g/Nm ³		g/Nm ³		mg/Nm ³		mg/Nm ³		mg/Nm ³		g/Nm ³		mg/Nm ³	
	TAL	BIm	TAL	BIm	TAL	BIm	TAL	BIm	TAL	BIm	TAL	BIm	TAL	BIm	TAL	BIm	TAL	BIm
Natural gas	Lean burn	-	-	-	0.30	0.25	0.50	New: 0.25 0.1 from 2025	9	9	60	-	-	-	-	New & existing: 1.3 from 2025	-	30
	Other	-	-	-	0.30	0.25	0.25	Existing: 0.1 from 2029	-	-	-	-	-	-	-	New & existing, λ=1: 0.3 from 2025	-	30
Mine gas	Lean burn	-	-	-	0.65	0.50	0.50	0.50	31	31	60	New: 30b 20 from 2020	-	9	-	New & existing: 1.3 from 2025	-	30
	Other	-	-	-	0.65	0.50	0.25	-	-	-	-		-	-	-	-	-	-
Biogas	Pilot injection	-	-	<3	2.0	0.50	1	New: 0.50g 0.1 from 2023 Existing: 0.1 from 2029	310	89	40	Existing: 30 ^{b,c}	-	-	-	New: 1.3 from 2023 Existing: 0.3 from 2029	-	30
				≥3	0.65		0.50				40		-	-	-			
	<3			1.0	0.50		60				-		-	-				
	≥3			0.65	0.50		60				-		-	-				
Sewage gas	Pilot injection	-	-	<3	2.0	0.50	1	New: 310 89 Existing: 0.1 from 2029	310	89	60	Existing: 30 ^{b,c}	-	-	-	New & existing: 1.3 from 2025	-	30
				≥3	0.65		0.50				60		-	-	-			
	<3			1.0	0.50		60				-		-	-				
	≥3			0.65	0.25		60				-		-	-				
Landfill gas	Lean burn	-	-	-	0.65	0.65	0.50	New: 31 Existing: 31; 310 for P<1 MW _{th}	310	-	60	New: 60b 40 from 2025 Existing: 40	-	9	-	-	-	30
							-				-		-		-		-	
	Other						-				-		-		0.25		-	

a - these limit values are specified in the 44th BImSchV with 3% reference oxygen and are converted to 5% in this table
 b - applies to spark-ignition or lean-burn engines; a limit value of 5 mg/m³ applies to other engines
 c - if formaldehyde emissions of up to 40 mg/m³ were measured during the last emission measurement before 05.12.2016, the limit values must be complied with from 05.02.2019
 d - for engines using selective catalytic or selective non-catalytic reduction
 e - limits do not apply to emergency engines or engines used for peak shaving for less than 300 h/y
 f - for emergency only engines, a limit of 60 mg/m³ applies
 g - limit applies to biogas engines operating < 300 h/y



CHINA | NON-ROAD - CONSTRUCTION

Stage I | Stage II | Stage III | Stage IV

Stage I/II standards for nonroad diesel engines, g/kWh						
Power	CO	HC	NOx	HC+NOx	PM	PN
Stage I †						
130 ≤ P ≤ 560	5.0	1.3	9.2	-	0.54	-
75 ≤ P < 130	5.0	1.3	9.2	-	0.7	-
37 ≤ P < 75	6.5	1.3	9.2	-	0.85	-
18 ≤ P < 37	8.4	2.1	10.8	-	1.0	-
8 ≤ P < 18	8.4	-	-	12.9	-	-
0 < P < 8	12.3	-	-	18.4	-	-
Stage II						
130 ≤ P ≤ 560	3.5	1.0	6.0	-	0.2	-
75 ≤ P < 130	5.0	1.0	6.0	-	0.3	-
37 ≤ P < 75	5.0	1.3	7.0	-	0.4	-
18 ≤ P < 37	5.5	1.5	8.0	-	0.8	-
8 ≤ P < 18	6.6	-	-	9.5	0.8	-
0 < P < 8	8.0	-	-	10.5	1.0	-
Stage III						
P > 560	3.5	-	-	6.4	0.20	-
130 ≤ P ≤ 560	3.5	-	-	4.0	0.20	-
75 ≤ P < 130	5.0	-	-	4.0	0.30	-
37 ≤ P < 75	5.0	-	-	4.7	0.40	-
P < 37	5.5	-	-	7.5	0.60	-
Stage IV						
P > 560*	3.5	0.40	3.5, 0.67*		0.10	-
130 ≤ P ≤ 560	3.5	0.19	2.0		0.025	5×10 ¹²
75 ≤ P < 130	5.0	0.19	3.3		0.025	5×10 ¹²
56 ≤ P < 75	5.0	0.19	3.3		0.025	5×10 ¹²
37 ≤ P < 56	5.0	-		4.7	0.025	5×10 ¹²
P < 37	5.5	-		7.5	0.60	-

† Stage I limits shall be achieved before any exhaust aftertreatment device.
 * Proposed limits | Applicable to mobile generator sets with Pmax > 900 kW diesel engines



INDIA | NON-ROAD - CONSTRUCTION

Bharat (CEV) Stage II | Bharat (CEV) Stage III

Bharat (CEV) Stage II - III emission standards for diesel construction machinery						
Engine Power	Date	CO	HC	HC+NO _x	NO _x	PM
<i>kW</i>		<i>g/kWh</i>				
Bharat (CEV) Stage II						
P < 8	2008.10	8.0	1.3	-	9.2	1.00
8 ≤ P < 19	2008.10	6.6	1.3	-	9.2	0.85
19 ≤ P < 37	2007.10	6.5	1.3	-	9.2	0.85
37 ≤ P < 75	2007.10	6.5	1.3	-	9.2	0.85
75 ≤ P < 130	2007.10	5.0	1.3	-	9.2	0.70
130 ≤ P < 560	2007.10	5.0	1.3	-	9.2	0.54
Bharat (CEV) Stage III						
P < 8	2011.04	8.0	-	7.5	-	0.80
8 ≤ P < 19	2011.04	6.6	-	7.5	-	0.80
19 ≤ P < 37	2011.04	5.5	-	7.5	-	0.60
37 ≤ P < 75	2011.04	5.0	-	4.7	-	0.40
75 ≤ P < 130	2011.04	5.0	-	4.0	-	0.30
130 ≤ P < 560	2011.04	3.5	-	4.0	-	0.20

Bharat (CEV) Stage III Useful Life Periods		
Power Rating		Useful Life Period
		<i>hours</i>
< 19 kW		3000
19-37 kW	constant speed	3000
	variable speed	5000
> 37 kW		8000



INDIA | NON-ROAD – POWER GENERATION

CPCB IV +

CPCB IV + Emission limits for genset engines up to 800kW Powered by CI engines							
Power Rating	Ign.	NOx	HC	Nox + HC	CO	PM	Smoke
		g/kWh					m ⁻¹
P ≤ 8	CI	-	-	7.5	3.5	0.30	0.7
8 < P ≤ 19	CI	-	-	4.7	3.5	0.30	0.7
19 < P ≤ 56	CI	-	-	4.7	3.5	0.03	0.7
56 < P ≤ 560	CI	0.40	0.19	-	3.5	0.02	0.7
560 < P ≤ 800	CI	0.67	0.19	-	3.5	0.03	0.7

Emission limits for diesel engines > 800 kW for generator sets				
Date	CO	NMHC	NOx	PM
	mg/Nm ³	mg C/Nm ³	ppm(v)	mg/Nm ³
Until 2003.06	150	150	1100	75 ^b
2003.07 - 2005.06	150	100	970 (710) ^a	75 ^c
2005.07	150	100	710 (360) ^a	75 ^c

a For engines in plants of total power rating above 75/150 MW located in urban/rural areas, respectively.
 b 150 mg/Nm³ for engines fueled with furnace oil.
 c 100 mg/Nm³ for engines fueled with furnace oil.

Emission standards for diesel engines ≤ 800 kW for generator sets (2014)					
Engine Power (P)	Date	CO	NOx+HC	PM	Smoke
		g/kWh			1/m
P ≤ 19 kW	2014.04	3.5	7.5	0.3	0.7
19 kW < P ≤ 75 kW	2014.04	3.5	4.7	0.3	0.7
75 kW < P ≤ 800 kW	2014.04	3.5	4.0	0.2	0.7



INDIA | NON-ROAD - AGRICULTURE

Bharat (Trem) Stage I | Bharat (Trem) Stage II | Bharat (Trem) Stage III | Bharat (Trem) Stage IV |
 Bharat (Trem) Stage V | Bharat (CEV) Stage IV | Bharat (CEV) Stage V

Bharat (Trem) Stage I - III A emission standards for diesel agricultural tractors						
Engine Power	Date	CO	HC	HC+NOx	NOx	PM
kW		g/kWh				
Bharat (Trem) Stage I						
All	1999.10	14.0	3.5	-	18.0	-
Bharat (Trem) Stage II						
All	2003.06	9.0	-	15.0	-	1.00
Bharat (Trem) Stage III						
All	2005.10	5.5	-	9.5	-	0.80
Bharat (Trem) Stage III A						
P < 8	2010.04	5.5	-	8.5	-	0.80
8 ≤ P < 19	2010.04	5.5	-	8.5	-	0.80
19 ≤ P < 37	2010.04	5.5	-	7.5	-	0.60
37 ≤ P < 75	2011.04	5.0	-	4.7	-	0.40
75 ≤ P < 130	2011.04	5.0	-	4.0	-	0.30
130 ≤ P < 560	2011.04	3.5	-	4.0	-	0.20

Bharat (CEV/Trem) Stage IV - V emission standards							
Engine Power	Date	CO	HC	NOx	PM	PN	Test Cycle
kW		g/kWh				1/kWh	
Bharat (CEV/Trem) Stage IV							
37 ≤ P < 56	CEV: 2021.04 Trem: 2023.01	5.0	4.7*		0.025	-	NRSC and NRTC
56 ≤ P < 130		5.0	0.19	0.4	0.025	-	
130 ≤ P < 560		3.5	0.19	0.4	0.025	-	
Bharat (CEV/Trem) Stage V							
P < 8	CEV: 2025.01 Trem: 2026.04	8.0	7.5*		0.4	-	NRSC
8 ≤ P < 19		6.6	7.5*		0.4	-	NRSC
19 ≤ P < 37		5.0	4.7*		0.015	1×10 ¹²	NRSC and NRTC
37 ≤ P < 56		5.0	4.7*		0.015	1×10 ¹²	
56 ≤ P < 130		5.0	0.19	0.4	0.015	1×10 ¹²	
130 ≤ P < 560		3.5	0.19	0.4	0.015	1×10 ¹²	NRSC
P ≥ 560		3.5	0.19	3.5	0.045	-	NRSC

* NOx + HC

Bharat (CEV/Trem) Stage IV - V Useful Life Periods		
Power Rating	Useful Life Period	
	hours	
≤ 37 kW	constant speed	3000
	variable speed	5000
> 37 kW	8000	



UNITED STATES | NON-ROAD

EPA Tier 1 | Tier 2 | Tier 3 | Tier 4

EPA Tier 1-3 nonroad diesel engine emission standards, g/kWh (g/bhp-hr)							
Engine Power	Tier	Year	CO	HC	NMHC ^a + NO _x	NO _x	PM
kW < 8 (hp < 11)	Tier 1	2000	8.0 (6.0)	-	10.5 (7.8)	-	1.0 (0.75)
	Tier 2	2005	8.0 (6.0)	-	7.55 (5.6)	-	0.8 (0.6)
8 ≤ kW < 19 (11 ≤ hp < 25)	Tier 1	2000	6.6 (4.9)	-	9.5 (7.1)	-	0.8 (0.6)
	Tier 2	2005	6.6 (4.9)	-	7.5 (5.6)	-	0.8 (0.6)
19 ≤ kW < 37 (25 ≤ hp < 50)	Tier 1	1999	5.5 (4.1)	-	9.5 (7.1)	-	0.8 (0.6)
	Tier 2	2004	5.5 (4.1)	-	7.5 (5.6)	-	0.6 (0.45)
37 ≤ kW < 75 (50 ≤ hp < 100)	Tier 1	1998	-	-	-	9.2 (6.9)	-
	Tier 2	2004	5.0 (3.7)	-	7.5 (5.6)	-	0.4 (0.3)
	Tier 3	2008	5.0 (3.7)	-	4.7 (3.5)	-	†
75 ≤ kW < 130 (100 ≤ hp < 175)	Tier 1	1997	-	-	-	9.2 (6.9)	-
	Tier 2	2003	5.0 (3.7)	-	6.6 (4.9)	-	0.3 (0.22)
	Tier 3	2007	5.0 (3.7)	-	4.0 (3.0)	-	†
130 ≤ kW < 225 (175 ≤ hp < 300)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2003	3.5 (2.6)	-	6.6 (4.9)	-	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	-	4.0 (3.0)	-	†
225 ≤ kW < 450 (300 ≤ hp < 600)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2001	3.5 (2.6)	-	6.4 (4.8)	-	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	-	4.0 (3.0)	-	†
450 ≤ kW < 560 (600 ≤ hp < 750)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2002	3.5 (2.6)	-	6.4 (4.8)	-	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	-	4.0 (3.0)	-	†
kW ≥ 560 (hp ≥ 750)	Tier 1	2000	11.4 (8.5)	1.3 (1.0)	-	9.2 (6.9)	0.54 (0.4)
	Tier 2	2006	3.5 (2.6)	-	6.4 (4.8)	-	0.2 (0.15)

† Not adopted, engines must meet Tier 2 PM standard.

EPA voluntary emission standards for nonroad diesel engines, g/kWh (g/bhp-hr)		
Rated Power (kW)	NMHC ^a + NO _x	PM
kW < 8	4.6 (3.4)	0.48 (0.36)
8 ≤ kW < 19	4.5 (3.4)	0.48 (0.36)
19 ≤ kW < 37	4.5 (3.4)	0.36 (0.27)
37 ≤ kW < 75	4.7 (3.5)	0.24 (0.18)
75 ≤ kW < 130	4.0 (3.0)	0.18 (0.13)
130 ≤ kW < 560	4.0 (3.0)	0.12 (0.09)
kW ≥ 560	3.8 (2.8)	0.12 (0.09)

Tier 4 emission standards—Engines up to 560 kW, g/kWh (g/bhp-hr)						
Category	Year	CO	NMHC	NMHC + NO _x	NO _x	PM
kW < 8 (hp < 11)	2008	8.0 (6.0)	-	7.5 (5.6)	-	0.4a (0.3)
8 ≤ kW < 19 (11 ≤ hp < 25)	2008	6.6 (4.9)	-	7.5 (5.6)	-	0.4 (0.3)
19 ≤ kW < 37 (25 ≤ hp < 50)	2008	5.5 (4.1)	-	7.5 (5.6)	-	0.3 (0.22)
	2013	5.5 (4.1)	-	4.7 (3.5)	-	0.03 (0.022)
37 ≤ kW < 56 (50 ≤ hp < 75)	2008	5.0 (3.7)	-	4.7 (3.5)	-	0.3 ^b (0.22)
	2013	5.0 (3.7)	-	4.7 (3.5)	-	0.03 (0.022)
56 ≤ kW < 130 (75 ≤ hp < 175)	2012-2014c	5.0 (3.7)	0.19 (0.14)	-	0.40 (0.30)	0.02 (0.015)
130 ≤ kW ≤ 560 (175 ≤ hp ≤ 750)	2011-2014d	3.5 (2.6)	0.19 (0.14)	-	0.40 (0.30)	0.02 (0.015)
Generator sets > 900 kW	2011	3.5 (2.6)	0.40 (0.30)	-	0.67 (0.50)	0.10 (0.075)
All engines except gensets > 900 kW		3.5 (2.6)	0.40 (0.30)	-	3.5 (2.6)	0.10 (0.075)
Generator sets	2015	3.5 (2.6)	0.19 (0.14)	-	0.67 (0.50)	0.03 (0.022)
All engines except gensets		3.5 (2.6)	0.19 (0.14)	-	3.5 (2.6)	0.04 (0.03)

a - hand-startable, air-cooled, DI engines may be certified to Tier 2 standards through 2009 and to an optional PM standard of 0.6 g/kWh starting in 2010

b - 0.4 g/kWh (Tier 2) if manufacturer complies with the 0.03 g/kWh standard from 2012

c - PM/CO: full compliance from 2012; NO_x/HC: Option 1 (if banked Tier 2 credits used)—50% engines must comply in 2012-2013; Option 2 (if no Tier 2 credits claimed)—25% engines must comply in 2012-2014, with full compliance from 2014.12.31

d - PM/CO: full compliance from 2011; NO_x/HC: 50% engines must comply in 2011-2013

3. MARITIME

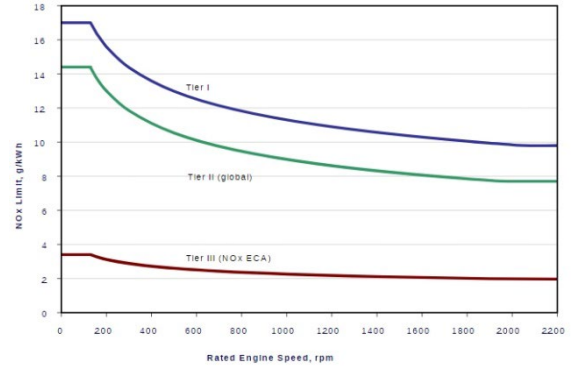


GLOBAL | MARITIME

IMO Tier I | IMO Tier II | IMO Tier III

MARPOL Annex NOx emissions limit				
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 ^{-0.23}	7.7
Tier III	2016*	3.4	9 n ^{-0.2}	1.96

* In NOx Emissions Control Areas (Tier II standards apply outside of ECAs).



EMISSION CONTROL AREAS (ECA)





EUROPE | MARITIME - INLAND WATERWAYS

Stage III | Stage V

Stage IIIA emissions standards for engines inland waterways vessels					
Category	Net Power	Date	CO	HC + NO _x	PM
	kW		g/kWh		
V1:1	D ≤ 0.9, P > 37 kW	2007	5.0	7.5	0.40
V1:2	0.9 < D ≤ 1.2		5.0	7.2	0.30
V1:3	1.2 < D ≤ 2.5		5.0	7.2	0.20
V1:4	2.5 < D ≤ 5		5.0	7.2	0.20
V2:1	5 < D ≤ 15	2009	5.0	7.8	0.27
V2:2	15 < D ≤ 20, P ≤ 3300 kW		5.0	8.7	0.50
V2:3	15 < D ≤ 20, P > 3300 kW		5.0	9.8	0.50
V2:4	20 < D ≤ 25		5.0	9.8	0.50
V2:5	25 < D ≤ 30		5.0	11.0	0.50

a A = 600 for gas engines | b HC + NO_x

Stage V emissions standards for engines inland waterways vessels (IWP & IWA)							
Category	Net Power	Date	CO	HC ^a	NO _x	PM	PN
	kW		g/kWh				1/kWh
IWP/IWA-v/c-1	19 ≤ P < 75	2019	5.00	4.70 ^b		0.30	-
IWP/IWA-v/c-2	75 ≤ P < 130	2019	5.00	5.40 ^b		0.14	-
IWP/IWA-v/c-3	130 ≤ P < 300	2019	3.50	1.00	2.10	0.10	-
IWP/IWA-v/c-4	P ≥ 300	2020	3.50	0.19	1.80	0.015	1 x 10 ¹²

a A = 600 for gas engines | b HC + NO_x



UNITED STATES | MARITIME

EPA Tier 3 | EPA Tier 4

Tier 3 Standards for Marine Diesel Category 1 Commercial Standard Power Density (≤ 35 kW/dm ³) Engines				
Power (P)	Displacement (D)	NO _x + HC [†]	PM	Date
<i>kW</i>	<i>dm³ per cylinder</i>	<i>g/kWh</i>	<i>g/kWh</i>	
P < 19	D < 0.9	7.5	0.40	2009
19 ≤ P < 75	D < 0.9 ^a	7.5	0.30	2009
		4.7 ^b	0.30 ^b	2014
75 ≤ P < 3700	D < 0.9	5.4	0.14	2012
	0.9 ≤ D < 1.2	5.4	0.12	2013
	1.2 ≤ D < 2.5	5.6	0.11 ^c	2014
	2.5 ≤ D < 3.5	5.6	0.11 ^c	2013
	3.5 ≤ D < 7	5.8	0.11 ^c	2012
Tier 3 Standards for Marine Diesel Category 2 Engines [‡]				
P < 3700	7 ≤ D < 15	6.2	0.14	2013
	15 ≤ D < 20	7.0	0.27 ^d	2014
	20 ≤ D < 25	9.8	0.27	2014
	25 ≤ D < 30	11.0	0.27	2014
[†] Tier 3 NO _x +HC standards do not apply to 2000-3700 kW engines. a - < 75 kW engines ≥ 0.9 dm ³ /cylinder are subject to the corresponding 75-3700 kW standards. ^b - Option: 0.20 g/kWh PM & 5.8 g/kWh NO _x +HC in 2014. c - This standard level drops to 0.10 g/kWh in 2018 for < 600 kW engines. [‡] Option: Tier 3 PM/NO _x +HC at 0.14/7.8 g/kWh in 2012, and Tier 4 in 2015. d - 0.34 g/kWh for engines below 3300kW.				

Tier 3 Standards for Marine Diesel Category 1 Commercial High Power Density (> 35 kW/dm ³) Engines and all Diesel Recreational Engines				
Power (P)	Displacement (D)	NO _x + HC [†]	PM	Date
<i>kW</i>	<i>dm³ per cylinder</i>	<i>g/kWh</i>	<i>g/kWh</i>	
P < 19	D < 0.9	7.5	0.40	2009
19 ≤ P < 75	D < 0.9 ^a	7.5	0.30	2009
		4.7 ^b	0.30 ^b	2014
75 ≤ P < 3700	D < 0.9	5.8	0.15	2012
	0.9 ≤ D < 1.2	5.8	0.14	2013
	1.2 ≤ D < 2.5	5.8	0.12	2014
	2.5 ≤ D < 3.5	5.8	0.12	2013
	3.5 ≤ D < 7	5.8	0.11	2012
^a - < 75 kW engines ≥ 0.9 dm ³ /cylinder are subject to the corresponding 75-3700 kW standards. ^b - Option: 0.20 g/kWh PM & 5.8 g/kWh NO _x +HC in 2014.				

Tier 4 Standards for Marine Diesel Category 1/2 Engines				
Power (P)	NOx	HC	PM	Date
<i>kW</i>	<i>g/kWh</i>	<i>g/kWh</i>	<i>g/kWh</i>	
P ≥ 3700	1.8	0.19	0.12 ^a	2014 ^c
	1.8	0.19	0.06	2016 ^{b,c}
2000 ≤ P < 3700	1.8	0.19	0.04	2014 ^{c,d}
1400 ≤ P < 2000	1.8	0.19	0.04	2016 ^c
600 ≤ P < 1400	1.8	0.19	0.04	2017 ^d

a - 0.25 g/kWh for engines with 15-30 dm³/cylinder displacement.
 b - Optional compliance start dates can be used within these model years.
 c - Option for Cat. 2: Tier 3 PM/NO_x+HC at 0.14/7.8 g/kWh in 2012, and Tier 4 in 2015.
 d - The Tier 3 PM standards continue to apply for these engines in model years 2014 and 2015 only.



CHINA | MARITIME

China I | China II

China I marine engine emission standards							
Cat.	Displ. (SV)	Power (P)	CO	HC+NOx	CH ¹ ₄	PM	Date
	<i>Dm per³ cylinder</i>	<i>kW</i>	<i>g/kWh</i>	<i>g/kWh</i>	<i>g/kWh</i>	<i>g/kWh</i>	
China I							
1	SV < 0.9	P ≥ 37	5.0	7.5	1.5	0.40	2018.7
	0.9 ≤ SV < 1.2		5.0	7.2	1.5	0.30	
	1.2 ≤ SV < 5		5.0	7.2	1.5	0.20	
2	5.0 ≤ SV < 15		5.0	7.8	1.5	0.27	2018.7
	15 ≤ SV < 20	P < 3300	5.0	8.7	1.6	0.50	
		P ≥ 3300	5.0	9.8	1.8	0.50	
	20 ≤ SV < 25		5.0	9.8	1.8	0.50	
	25 ≤ SV < 30		5.0	11.0	2.0	0.50	
China II							
1	SV < 0.9	P ≥ 37	5.0	5.8	1.0	0.3	2021.07
	0.9 ≤ SV < 1.2		5.0	5.8	1.0	0.14	
	1.2 ≤ SV < 5		5.0	5.8	1.0	0.12	
2	5 ≤ SV < 15	P < 2000	5.0	6.2	1.2	0.14	2021.07
		2000 ≤ P < 3700	5.0	7.8	1.5	0.14	
		P ≥ 3700	5.0	7.8	1.5	0.27	
	5 ≤ SV < 15	P < 2000	5.0	7.0	1.5	0.34	
		2000 ≤ P < 3300	5.0	8.7	1.6	0.50	
		P ≥ 3300	5.0	9.8	1.8	0.50	
	20 ≤ SV < 25	P < 2000	5.0	9.8	1.8	0.27	
		P ≥ 2000	5.0	9.8	1.8	0.50	
	25 ≤ SV < 30	P < 2000	5.0	11.0	2.0	0.27	
		P ≥ 2000	5.0	11.0	2.0	0.50	
1 Applicable to natural gas (including dual fuel) engines only.							

Useful life and durability test periods China I & II			
Category	Useful Life		Min Durability Test
	hours	years	hours
Category 1 & Category 2	10,000	10	2,500
Category 1—Recreational	1,000	10	500
Note: The useful life is specified in hours and years, whichever occurs first.			