GLOBAL EMISSIONS STANDARDS

Contents

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	NOx	NH_3	N_2O	PM	PN	Smoke
			g/kWh							*1/kWh*	*1/m*
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^{11}[b]	-
Euro VII	2028.05.29		1.5	0.080[d]	0.5	0.2	0.06	0.2	0.008	6.0×10^{11}[c]	-

a PM = 0.13 g/kWh for engines < 0.75 dm^3 swept volume per cylinder and a rated power speed > 3000 min-1
b PN_{23}
c PN_{10}
d NMOG

EU emission standards for heavy-duty CI (diesel) and PI engines: Transient testing

Stage	Date	Test	CO	NMHC	CH4a	NOx	NH3	N2O	PM[b]	PN
			g/kWh							1/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	-	-	0.16c	-
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	6.0×1011e
Euro VII	2028.05.29		1.5	0.080[g]	0.5	0.2	0.06	0.2	0.008	6.0×1011f

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 dm^3 swept volume per cylinder and a rated power speed > 3000 min^{-1}
d THC for diesel (CI) engines
e PN_{23}. PN limit for PI engines applies for Euro VI-B and later [4374]
f PN_{10}
g NMOG

EU emission standards for heavy-duty CI (diesel) and PI engines: RDE testing

Stage	Date	Test	CO	NMHC	CH4a	NOx	NH3	N2O	PN_{10}
			g/kWh						1/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**	**NOx**	**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	CH4	NOX	PM	PN	NH3
		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	NOx	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**
		Mean(max)	*Mean(max)*	*Mean(max)*	*Mean(max)*
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				*1/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+NOx	NOx	PM
	kW			*g/kWh*			
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	NOx	PM	PN
		kW		*g/kWh*				*1/kWh*
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+NOx
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**	**NOx**	**PM**	**PN**
		kW		*g/kWh*				*1/kWh*
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**	**NOx+HC**	**PM**	**Power**
		MW_{th}	*mg/Nm^3*		
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+NOx	NOx	PM
	kW		*g/kWh*				
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]	NOx	PM	PN
	kW		*g/kWh*				*1/kWh*
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% O2

Gaseous Fuel	Engine Type		Power		CO[e]		NOx[e]		SOx[a,e]		HCHO		TD[a]		TC[e]		NH_3[d]	
			MW_{th}		*g/Nm³*		*g/Nm³*		*mg/Nm³*		*mg/Nm³*		*mg/Nm³*		*g/Nm³*		*mg/Nm³*	
	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 Existing: 0.1 from 2029	9	9	60	New: 30b 20 from 2020 Existing: 30[b,c]	-	-	-	New & existing: 1.3 from 2025	-	30
	Other						0.25						-		-	New & existing, λ=1: 0.3 from 2025	-	
Mine gas	Lean burn	-	-	-	0.65	0.50	0.50	0.50	31	31	60		-	9	-	New & existing: 1.3 from 2025	-	30
	Other						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		-	-	-	New: 1.3 from 2023 Existing: 0.3 from 2029	-	30
			≥3		0.65		0.50				40		-	-	-		-	
	Spark ignition		<3		1.0		0.50				60		-	-	-		-	
			≥3		0.65		0.50				60		-	-	-		-	
Sewage gas	Pilot injection	-	<3	-	2.0	0.50	1	0.50	310	89	60		-	-	-	New & existing: 1.3 from 2025	-	30
			≥3		0.65		0.50				60		-	-	-		-	
	Spark ignition		<3		1.0		0.50				60		-	-	-		-	
			≥3		0.65		0.25				60		-	-	-		-	
Landfill gas	Lean burn	-	-	-	0.65	0.65	0.50	-	310	New: 31 Existing: 31; 310 for P<1 MW_{th}	60	New: 60b 40 from 2025 Existing: 40	-	9	-		-	30
			-										-		-		-	
	Other		-				0.25	-			60		-		-		-	
			-										-		-		-	

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**
kW		*g/kWh*				
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**
		hours
< 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	-	
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}	
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; NOx/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

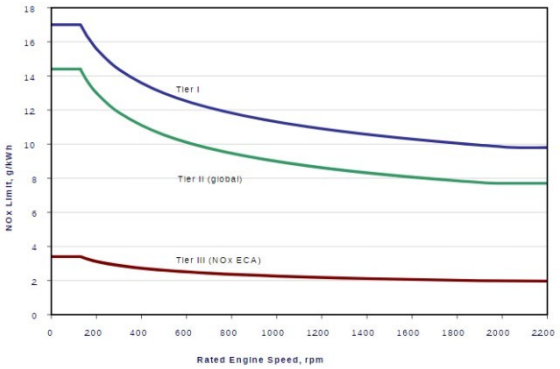
d - PM/CO: full compliance from 2011; NOx/HC: 50% engines must comply in 2011-2013

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 III A 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 + NOx					

Stage V emissions standards for engines inland waterways vessels (IWP & IWA)							
Category	Net Power	Date	CO	HC[a]	NOx	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	1×10^{12}
a A = 600 for gas engines | b HC + NOx							

UNITED STATES| MARITIME

EPA Tier 3 | EPA Tier 4

Tier 3 Standards for Marine Diesel Category 1 Commercial Standard Power Density (≤ 35 kW/dm3) Engines				
Power (P)	**Displacement (D)**	**NOx + HC†**	**PM**	**Date**
kW	*dm^3 per cylinder*	*g/kWh*	*g/kWh*	
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 NOx+HC standards do not apply to 2000-3700 kW engines. | a - < 75 kW engines ≥ 0.9 dm3/cylinder are subject to the corresponding 75-3700 kW standards.

b - Option: 0.20 g/kWh PM & 5.8 g/kWh NOx+HC in 2014. | c - This standard level drops to 0.10 g/kWh in 2018 for < 600 kW engines.

‡ Option: Tier 3 PM/NOx+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/dm3) Engines and all Diesel Recreational Engines				
Power (P)	**Displacement (D)**	**NOx + HC†**	**PM**	**Date**
kW	*dm^3 per cylinder*	*g/kWh*	*g/kWh*	
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 dm3/cylinder are subject to the corresponding 75-3700 kW standards.

b - Option: 0.20 g/kWh PM & 5.8 g/kWh NOx+HC in 2014.

Tier 4 Standards for Marine Diesel Category 1/2 Engines				
Power (P)	**NOx**	**HC**	**PM**	**Date**
kW	*g/kWh*	*g/kWh*	*g/kWh*	
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 dm^3/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 4 [1]**	**PM**	**Date**
	Dm per cylinder	*kW*	*g/kWh*	*g/kWh*	*g/kWh*	*g/kWh*	
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.			