



**Economic and Social
Council**

Distr.
GENERAL

ECE/EB.AIR/WG.5/2009/20
16 June 2009

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

EXECUTIVE BODY FOR THE CONVENTION ON LONG-RANGE
TRANSBOUNDARY AIR POLLUTION

Working Group on Strategies and Review

Forty-fifth session
Geneva, 31 August–4 September 2009
Item 4 of the provisional agenda

OPTIONS FOR REVISING THE GOTHENBURG PROTOCOL

DRAFT REVISED TECHNICAL ANNEX VIII

Note by the secretariat

Summary

At its forty-fourth session in April 2009, the Working Group on Strategies and Review welcomed the work carried out by the Expert Group on Techno-economic issues on updating the technical annexes IV, V, VI and VIII and the guidance documents and on elaborating new annexes on volatile organic compounds (VOC) in products and on particulate matter (PM). It requested the secretariat to submit them as official documents for negotiation at the forty-fifth session of the Working Group (ECE/EB.AIR/WG.5/96, para. 42 (d–e)). This note presents a draft revised technical annex VIII as suggested by the Expert Group on Techno-economic Issues.

Annex VIII

LIMIT VALUES FOR FUELS AND NEW MOBILE SOURCES

Section A applies to Parties other than Canada and the United States of America, section B applies to Canada and section C applies to the United States of America.

1. The annex contains limit values for NO_x, expressed as nitrogen dioxide (NO₂) equivalents, for hydrocarbons, most of which are volatile organic compounds, for carbon monoxide (CO) and for dust¹ as well as environmental specifications for marketed fuels for vehicles.

2. The timescales for applying the limit values in this annex are laid down in annex [X].

A. Parties other than Canada and the United States of America

Passenger cars and light-duty vehicles

3. Limit values for power-driven vehicles with at least four wheels and used for the carriage of passengers (category M) and goods (category N) are given in table 1. They are based on the European regulations Euro 3 to Euro 6.

Heavy-duty vehicles

4. Limit values for engines for heavy-duty vehicles are given in tables 2 and 3 depending on the applicable test procedures.

Compression-ignition (CI) and spark-ignition (SI) non-road vehicles and machines

5. Limit values for agricultural and forestry tractors and other non-road vehicle/machine engines are listed in tables 4 to 8.

Stages I and II for CI engines to be installed on non-road mobile machines are based on Directive 1997/68/EC. Stages I and II for CI engines intended to power agricultural and forestry tractors are based on Directive 2000/25/EC. Stages IIIA to IV for CI engines are based on

¹ In the context of this Protocol, dust and TSP have the same meaning. In the following tables, the terms Particulate Matter or Particulates are used to keep the coherence with the EC directives used.

Directive 2004/26/EC. Stages IIIA to IV for engines intended to power agricultural and forestry tractors are based on Directive 2005/13/EC.

Stages I and II for SI engines to be installed on non-road mobile machines are based on Directive 2002/88/EC.

Locomotives and railcars

6. Limit values for locomotives and railcars are listed in tables 9 to 12. Stages IIIA and IIIB are based on Directive 2004/26/EC.

Inland waterway vessels

7. Limit values for inland waterway vessels are listed in table 13. Stage IIIA is based on Directive 2004/26/EC.

Recreational crafts

8. Limit values for inland waterway vessels are listed in table 14. Stage IIIA is based on Directive 2003/44/EC.

Motorcycles and mopeds

9. Limit values for motorcycles and mopeds are given in tables 15 to 18. They are based on the European regulation.

Fuel quality

10. Environmental quality specifications for petrol and diesel are given in tables 19 to 20.

Table 1: Limit values for passenger cars and light-duty vehicles

		Reference mass (RW) (kg)	Limit values												
			Carbon monoxide		Hydrocarbons (HC)		NMVOC		Nitrogen oxides		Hydrocarbons and nitrogen oxides combined		Particulates ^{a/}		
			L1 (g/km)		L2 (g/km)		L3 (g/km)		L4 (g/km)		L2 + L4 (g/km)		L5 (g/km)		
Category	Class		Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	
Euro 3	M ^{b/}	All	2.3	0.64	0.20	-	-	-	0.15	0.50	-	0.56	-	0.05	
	N ₁ ^{c/}	I	RW ≤ 1305	2.3	0.64	0.20	-	-	-	0.15	0.50	-	0.56	-	0.05
		II	1305 < RW ≤ 1760	4.17	0.80	0.25	-	-	-	0.18	0.65	-	0.72	-	0.07
		III	1760 < RW	5.22	0.95	0.29	-	-	-	0.21	0.78	-	0.86	-	0.10
Euro 4	M ^{b/}	All	1.0	0.50	0.10	-	-	-	0.08	0.25	-	0.30	-	0.025	
	N ₁ ^{c/}	I	RW 1305	1.0	0.50	0.10	-	-	-	0.08	0.25	-	0.30	-	0.025
		II	1305 < RW ≤ 1760	1.81	0.63	0.13	-	-	-	0.10	0.33	-	0.39	-	0.04
		III	1760 < RW	2.27	0.74	0.16	-	-	-	0.11	0.39	-	0.46	-	0.06
Euro 5	M ^{b/}	All	1.0	0.50	0.10	-	0.068	-	0.06	0.18	-	0.23	0.005	0.005	
	N ₁ ^{c/}	I	RW 1305	1.0	0.50	0.10	-	0.068	-	0.06	0.18	-	0.23	0.005	0.005
		II	1305 < RW ≤ 1760	1.81	0.63	0.13	-	0.090	-	0.075	0.235	-	0.295	0.005	0.005
		III	1760 < RW	2.27	0.74	0.16	-	0.108	-	0.082	0.28	-	0.35	0.005	0.005
	N ₂		2.27	0.74	0.16	-	0.108	-	0.082	0.28	-	0.35	0.005	0.005	
Euro 6	M ^{b/}	All	1.0	0.50	0.10	-	0.068	-	0.06	0.08	-	0.17	0.005	0.005	
	N ₁ ^{c/}	I	RW ≤ 1305	1.0	0.50	0.10	-	0.068	-	0.06	0.08	-	0.17	0.005	0.005
		II	1305 < RW ≤ 1760	1.81	0.63	0.13	-	0.090	-	0.075	0.105	-	0.195	0.005	0.005
		III	1760 < RW	2.27	0.74	0.16	-	0.108	-	0.082	0.125	-	0.215	0.005	0.005
	N ₂		2.27	0.74	0.16	-	0.108	-	0.082	0.125	-	0.215	0.005	0.005	

a/ VLE expressed as a number of particulates /km are also defined for Euro 6

b/ Except vehicles whose maximum mass exceeds 2,500 kg.

c/ And those category M vehicles specified in note b.

Table 2: Limit values for heavy-duty vehicles - European steady-state cycle (ESC) and European load-response (ELR) tests

Row	Carbon monoxide (g/kWh)	Hydrocarbons (g/kWh)	Nitrogen oxides (g/kWh)	Particulates (g/kWh)	Smoke
					(m ⁻¹)
A	2.1	0.66	5.0	0.10 / 0.13 ^{a/}	0.8
B1	1.5	0.46	3.5	0.02	0.5
B2	1.5	0.46	2.0	0.02	0.5

a/ For engines with a swept volume below 0.75 dm³ per cylinder and a rated power speed above 3,000 revolutions per minute.

Table 3: Limit values for heavy-duty vehicles - European transient cycle (ETC) test

Row	Carbon monoxide (g/kWh)	Non-methane hydrocarbons (g/kWh)	Methane ^{a/} (g/kWh)	Nitrogen oxides (g/kWh)	Particulates ^{b/}
A (2000)	5.45	0.78	1.6	5.0	0.16 / 0.21 ^{c/}
B1 (2005)	4.0	0.55	1.1	3.5	0.03
B2 (2008)	4.0	0.55	1.1	2.0	0.03

a/ For natural gas engines only.

b/ Not applicable to gas-fuelled engines at stage A and stages B1 and B2.

c/ For engines with a swept volume below 0.75 dm³ per cylinder and a rated power speed above 3,000 revolutions per minute.

Table 4: Limit values (stage IIIA) for diesel engines for non-road mobile machines, agricultural and forestry tractors

Net power (P) (kW)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)	Particulate matter (g/kWh)
130 ≤ P ≤ 560	3.5	4.0	0.2
75 ≤ P < 130	5.0	4.0	0.3
37 ≤ P < 75	5.0	4.7	0.4
19 ≤ P < 37	5.5	7.5	0.6

Table 5: Limit values (stage IIIB) for diesel engines for non-road mobile machines, agricultural and forestry tractors

Net power (P) (kW)	Carbon monoxide (g/kWh)	Hydrocarbons (g/kWh)	Nitrogen oxides (g/kWh)	Particulate matter (g/kWh)
130 ≤ P ≤ 560	3.5	0.19	2.0	0.025
75 ≤ P < 130	5.0	0.19	3.3	0.025
56 ≤ P < 75	5.0	0.19	3.3	0.025
37 ≤ P < 56	5.0	4.7		0.025

Table 6: Limit values (stage IV) for diesel engines for non-road mobile machines, agricultural and forestry tractors

Net power (P) (kW)	Carbon monoxide (g/kWh)	Hydrocarbons (g/kWh)	Nitrogen oxides (g/kWh)	Particulate matter (g/kWh)
$130 \leq P \leq 560$	3.5	0.19	0.4	0.025
$56 \leq P < 130$	5.0	0.19	0.4	0.025

Table 7: Limit values (stage I) for spark-ignition engines for non-road mobile machines

Hand-held engines			
Displacement (cm ³)	Carbon monoxide (g/kWh)	Hydrocarbons (g/kWh)	Nitrogen oxides (g/kWh)
Disp < 20	805	295	5.36
$20 \leq \text{disp.} < 50$	805	241	5.36
Disp ≥ 50	603	161	5.36
Non-hand-held engines			
Displacement (cm ³)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)	
Disp < 66	519	50	
$66 \leq \text{disp.} < 100$	519	40	
$100 \leq \text{disp.} < 225$	519	16.1	
Disp ≥ 225	519	13.4	

Table 8: Limit values (stage II) for spark-ignition engines for non-road mobile machines

Hand-held engines		
Displacement (cm ³)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh) ^{a/}
Disp < 20	805	50
$20 \leq \text{disp.} < 50$	805	50
Disp ≥ 50	603	72
Non-hand-held engines		
Displacement (cm ³)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)
Disp < 66	519	50
$66 \leq \text{disp.} < 100$	519	40
$100 \leq \text{disp.} < 225$	519	16.1
Disp ≥ 225	519	12.4

a/ The NOx emissions for all engine classes must not exceed 10 g/kWh.

Table 9: Limit values (stage IIIA) for propulsion of locomotives

Net power (P) (kW)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)		Particulate matter (g/kWh)
RL A: $130 \leq P \leq 560$	3.5	4.0		0.2
Net power (P) (kW)	Carbon monoxide (g/kWh)	Hydrocarbons (g/kWh)	Nitrogen oxides (g/kWh)	Particulate matter (g/kWh)
RH A: $P > 560$	3.5	0.4	6.0	0.2
RH A: Engines with $P > 2,000$ and disp. > 5 l/cylinder	3.5	0.4	7.4	0.2

Table 10: Limit values (stage IIIA) for propulsion of railcars

Net power (P) (kW)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)		Particulate matter (g/kWh)
RCA: $130 < P$	3.5	4.0		0.2

Table 11: Limit values (stage IIIB) for propulsion of railcars

Net power (P) (kW)	Carbon monoxide (g/kWh)	Hydrocarbons (g/kWh)	Nitrogen oxides (g/kWh)	Particulate matter (g/kWh)
RCA: $130 < P$	3.5	0.19	2.0	0.025

Table 12: Limit values (stage IIIB) for propulsion of locomotives

Net power (P) (kW)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)		Particulate matter (g/kWh)
RCA: $130 < P$	3.5	4.0		0.025

Table 13: Limit values (stage IIIA) for propulsion of inland waterways vessels

Displacement (liters per cylinder/kW)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)		Particulate matter (g/kWh)
V1:1 Disp. < 0.9 Power ≥ 37 kW	5.0	7.5		0.4
V1:2 $0.9 \leq \text{disp.} < 1.2$	5.0	7.2		0.3
V1:3 $1.2 \leq \text{disp.} < 2.5$	5.0	7.2		0.2
V1:4 $2.5 \leq \text{disp.} < 5.0$	5.0	7.2		0.2
V2:1 $5.0 \leq \text{disp.} < 15$	5.0	7.8		0.27

Displacement (liters per cylinder/kW)	Carbon monoxide (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (g/kWh)	Particulate matter (g/kWh)
V2:2 15 ≤ disp. < 20 Power < 3300 kW	5.0	8.7	0.5
V2:3 15 ≤ disp. < 20 Power > 3300 kW	5.0	9.8	0.5
V2:4 20 ≤ disp. < 25	5.0	9.8	0.5
V2:5 25 ≤ disp. < 30	5.0	11.0	0.5

Table 14: Limit values for recreational crafts

Engine type	CO (g/kWh) CO = A + B/P _N ⁿ			VOC (g/kWh) VOC = A + B/P _N ⁿ			NO _x [g/kWh]	PM [g/kWh]
	A	B	n	A	B	n		
2-stroke	150	600	1	30	100	0,75	10	Not Appl.
4-stroke	150	600	1	6	50	0,75	15	Not Appl.
CI	5	0	0	1,5	2	0,5	9,8	1

Not Appl.: Not Applicable

Where A, B and n are constants in accordance with table 3.1.1, P_N is the rate engine power in kW and the emissions are measured in accordance with the harmonised standards.

Table 15: Limit values (stage I) for motorcycles and 3- and 4-wheelers (> 50 cm³; > 45 km/h)

Engine type	Limit values
2-stroke	CO = 8 g/km HC = 4 g/km NO _x = 0.1 g/km
4-stroke	CO = 13 g/km HC = 3 g/km NO _x = 0.3 g/km

Note: For 3- and 4-wheelers, the limit values have to be multiplied by 1.5.

Table 16: Limit values (stage II) for motorcycles (> 50 cm³; > 45 km/h)

Engine type	Limit values
Motorcycle < 150cc	HC = 1.2 g/km NO _x = 0.3 g/km
Motorcycle > 150cc	HC = 1.0 g/km NO _x = 0.3 g/km

Table 17: Limit values (stage III) for motorcycles (> 50 cm³; > 45 km/h)

Engine type	Limit values
Motorcycle < 150cc	HC = 0.8 g/km NO _x = 0.15 g/km
Motorcycle > 150cc	HC = 0.3 g/km NO _x = 0.15 g/km

Table 18: Limit values for mopeds (50 cm³; < 45 km/h)

Stage	Limit values	
	CO (g/km)	HC + NO _x (g/km)
I	6.0 ^{a/}	3.0 ^{a/}
II	1.0 ^{b/}	1.2

a/ For 3- and 4-wheelers, multiply by 2.

b/ For 3- and 4-wheelers, 3.5 g/km.

Table 19: Environmental specifications for marketed fuels to be used for vehicles equipped with positive-ignition engines

Type: Petrol

Parameter	Unit	Limits	
		Minimum	Maximum
Research octane number		95	-
Motor octane number		85	-
Reid vapour pressure, summer period ^{a/}	kPa	-	60
Distillation:			
evaporated at 100°C	% v/v	46	-
evaporated at 150°C	% v/v	75	-
Hydrocarbon analysis:			
- olefins	% v/v	-	18.0 ^{b/}
- aromatics		-	35
- benzene		-	1
Oxygen content	% m/m	-	2.7
Oxygenates:			
- Methanol, stabilizing agents must be added	% v/v	-	3
- Ethanol, stabilizing agents may be necessary	% v/v	-	5
- Iso-propyl alcohol	% v/v	-	10
- Tert-butyl alcohol	% v/v	-	7
- Iso-butyl alcohol	% v/v	-	10

Parameter	Unit	Limits	
		Minimum	Maximum
- Ethers containing 5 or more carbon atoms per molecule	% v/v	-	15
Other oxygenates ^{c/}	% v/v	-	10
Sulphur content	mg/kg	-	10

a/ The summer period shall begin no later than 1 May and shall not end before 30 September. For member States with arctic conditions the summer period shall begin no later than 1 June and not end before 31 August and the RVP is limited to 70 kPa.

b/ Except for regular unleaded petrol (minimum motor octane number (MON) of 81 and minimum research octane number (RON) of 91), for which the maximum olefin content shall be 21% v/v. These limits shall not preclude the introduction on the market of a member State of another unleaded petrol with lower octane numbers than set out here.

c/ Other mono-alcohols with a final distillation point no higher than the final distillation point laid down in national specifications or, where these do not exist, in industrial specifications for motor fuels.

Table 20: Environmental specifications for marketed fuels to be used for vehicles equipped with compression-ignition engines

Type: Diesel fuel

Parameter	Unit	Limits	
		Minimum	Maximum
Cetane number		51	-
Density at 15°C	kg/m ³	-	845
Distillation point: 95%	°C	-	360
Polycyclic aromatic hydrocarbons	% m/m	-	11
Sulphur content	mg/kg	-	10

B. Canada²

11 New vehicle emission standards for light-duty vehicles, light-duty trucks, heavy-duty vehicles, heavy-duty engines and motorcycles: Motor Vehicle Safety Act (and successor legislation), Schedule V of the Motor Vehicle Safety Regulations: Vehicle Emissions (Standard 1100), SOR/97-376, (28 July, 1997), as amended from time to time.

12. Canadian Environmental Protection Act, Diesel Fuel Regulations, SOR/97-110 (4 February, 1997, sulphur in diesel fuel), as amended from time to time.

² Up to now, no information has been provided by North America, therefore part B and C of the annex have not been modified yet

13. Canadian Environmental Protection Act, Benzene in Gasoline Regulations, SOR/97-493 (6 November, 1997), as amended from time to time.

14. Canadian Environmental Protection Act, Sulphur in Gasoline Regulations, Canada Gazette, Part II, June 4, 1999, as amended from time to time.

C. United States of America²

15. Implementation of a mobile source emission control programme for light-duty vehicles, light-duty trucks, heavy-duty trucks and fuels to the extent required by sections 202 (a), 202 (g) and 202 (h) of the Clean Air Act, as implemented through:

- (a) 40 Code of Federal Regulations (C.F.R.) Part 80, Subpart D - Reformulated Gasoline;
- (b) 40 C.F.R. Part 86, Subpart A - General Provisions for Emission Regulations;
- (c) 40 C.F.R. Part 80, section 80.29 -- Controls and Prohibitions on Diesel Fuel Quality.
