Determination of idling emission factors for Liantang/Heung Yuen Wai BCP

1. Background

Emissions from idling engines in the VHA of the new BCP are one of the major issues in determining the environmental acceptability of the proposed project. Although only at planning stage, attempts have been made to assess the environmental impact quantitatively as far as possible. Emissions solely due to idling engines, however, are not often quantified in local or overseas environmental studies in the past, nor has it been officially updated regularly by local or overseas environmental agencies. As idling emissions are the key environmental issue of this study, it is necessary to ensure that a set of rational and reasonable idling emission factors have been adopted for simulating the actual situation.

2. Assessment Methodology

While the latest Emfac-HK model would generate a set of accurate prediction of the travelling vehicle emission factors, it was not dedicated to the calculation of idling emissions from vehicles, which account for most of the emissions from the BCP. Other more appropriate approach to estimating the idling emissions from the BCP has therefore been sought.

Appendix of the report "Road Tunnels: Vehicle Emissions and Air Demand for Ventilation" published by the Permanent International Association of Road Congresses (PIARC) in November 2004 (**Attachment 1**) presented the emission factors for different Euro engine types under different traveling speeds and gradients, including idling mode (i.e. v=0). Emission factors presented in the document has been adopted for deriving the idling emission factors for this project.

In determining the composite idling emission factors in the assessment year which takes account of the age distribution and technology fraction of different engine types, it has been assumed that the age profile of vehicles in 2003 as shown on EPD's website and replicated in Table 1 below would be the same in the assessment year (say the commissioning year, 2016).

Table 1: Age population profile of vehicles in Yr 2003

Age	PC	HGV(7)	HGV(8)
1	6.70	3.50	4.31
2	8.77	3.88	4.82
3	10.05	4.12	4.80
4	9.86	4.89	7.34
5	8.23	4.61	4.45
6	9.19	4.07	4.60
7	11.43	6.56	7.71
8	5.88	4.73	6.56
9	5.65	5.53	6.05
10	7.58	8.11	7.02
11	6.70	11.29	7.82
12	4.83	13.47	10.07
13	2.02	9.54	7.21
14	1.21	5.06	5.40
15	0.72	3.56	4.05
16	0.40	3.24	3.45
17	0.22	2.07	2.28
18	0.15	0.97	0.78
19	0.07	0.46	0.91
20	0.03	0.26	0.15
21	0.02	0.02	0.05
22	0.05	0.03	0.07
23	0.05	0.03	0.03
24	0.04	0.00	0.05
25	0.02	0.00	0.00

Age	PC	HGV(7)	HGV(8)
26	0.02	0.00	0.00
27	0.02	0.00	0.00
28	0.01	0.00	0.01
29	0.01	0.00	0.00
30	0.01	0.00	0.00
31	0.02	0.00	0.00
32	0.01	0.00	0.00
33	0.01	0.00	0.00
34	0.01	0.00	0.00
35	0.00	0.00	0.00
36	0.00	0.00	0.00
37	0.00	0.00	0.00
38	0.00	0.00	0.00
39	0.00	0.00	0.00
40	0.00	0.00	0.00
41	0.00	0.00	0.00
42	0.00	0.00	0.00
43	0.00	0.00	0.00
44	0.00	0.00	0.00
>44	0.00	0.00	0.00
Total	100%	100%	100%
Total Number of Vehicle	338,618	9,714	32,012

Source: "Up To Date Vehicle Licensed Number by Age and Technology Group Fractions" from EPD website http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac.html

By making reference to the implementation years of various emission standard policies, the fraction of vehicles fulfilling a certain emission standard could be obtained. Table 2 shows the implementation years of various emission standards policies in Hong Kong. Consideration has also been given to the age distribution of vehicles registered in the transition years where new emission standard was introduced in the middle of the year. Tables 3 and 4 show the apportionment of vehicle population for goods vehicles and private cars registered in those years respectively.

Table 2: Implementation years of emission standards in Hong Kong

Tier	Private Car	Goods Vehicle
Pre-Euro	Before Jan 1992	Before Apr 1995
Euro I	Apr 1995	Apr 1995
Euro II	Apr 1997	Apr 1007
Euro III	Jan 2001	Oct 2001
Euro IV	Jan 2006	Oct 2006
Euro V	--	Oct 2009

Source: Appendix 2 to "Guideline on Modeling Vehicle Emissions", EPD, July 2005

Table 3: Percentage of goods vehicles of different engine standards

First Reg Year	Euro Standard	HGV(7) %	HGV(8) %
1995	Pre-Euro	29.8	27.3
	Euro I	70.2	72.7
1997	Euro I	22.0	22.2
	Euro II	78.0	77.8
2001	Euro II	75.3	84.2
	Euro III	24.7	15.8

Source: "Up To Date Vehicle Licensed Number by Age and Technology Group Fractions" from EPD website http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac.html

Table 4: Percentage of private cars of different engine standards

First Reg Year	Euro Standard	PC %
1995	Pre-Euro	38.4
	Euro I	60.8
1997	Euro I	19.8
	Euro II	80.1

Source: "Up To Date Vehicle Licensed Number by Age and Technology Group Fractions" from EPD website http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac.html

From the above information, the engine type distribution in the assessment year (e.g. 2016) is predicted and presented in Table 5.

Table 5: Predicted engine type distribution in 2016

Age	First Reg Year	Private Car			Goods Vehicle			
		% by age	% of vehicle population having engines of same Euro type	Euro Standard	HGV(7) % by age	HGV(8) % by age	% of vehicle population having engines of same Euro type[4]	Euro Standard
1	2016	6.70	90.1	IV	3.50	4.31	36.5	V
2	2015	8.77			3.88	4.82		
3	2014	10.05			4.12	4.80		
4	2013	9.86			4.89	7.34		
5	2012	8.23			4.61	4.45		
6	2011	9.19			4.07	4.60		
7	2010	11.43			6.56	7.71		
8	2009	5.88			4.73[1]	6.56[1]	19.3	IV
9	2008	5.65			5.53	6.05		
10	2007	7.58			8.11	7.02		
11	2006	6.70			11.29[2]	7.82[2]	37.1	III
12	2005	4.83	9.2	III	13.47	10.07		
13	2004	2.02			9.54	7.21		
14	2003	1.21			5.06	5.40		
15	2002	0.72			3.56	4.05		
16	2001	0.40			3.24[3]	3.45[3]	6.8	II
17	2000	0.22	0.5	II	2.07	2.28		
18	1999	0.15			0.97	0.78		
19	1998	0.07			0.46	0.91		
20	1997	0.03[3]			0.26	0.15[3]		
21	1996	0.02	0.1	I	0.02	0.05	0.1	I
22	1995	0.05[3]	0.3	Pre-Euro	0.03	0.07[3]	0.1	Pre-Euro
23	1994	0.05			0.03	0.03		
24	1993	0.04			0.00	0.05		
25	1992	0.02			0.00	0.00		
26	1991	0.02			0.00	0.00		
27	1990	0.02			0.00	0.00		
28	1989	0.01			0.00	0.01		
29	1988	0.01			0.00	0.00		
30	1987	0.01			0.00	0.00		
31	1986	0.02			0.00	0.00		
32	1985	0.01			0.00	0.00		
33	1984	0.01			0.00	0.00		
34	1983	0.01			0.00	0.00		
35	1982	0.00			0.00	0.00		

Age	First Reg Year	Private Car			Goods Vehicle			
		% by age	% of vehicle population having engines of same Euro type	Euro Standard	HGV(7) % by age	HGV(8) % by age	% of vehicle population having engines of same Euro type[4]	Euro Standard
36	1981	0.00			0.00	0.00		
37	1980	0.00			0.00	0.00		
38	1979	0.00			0.00	0.00		
39	1978	0.00			0.00	0.00		
40	1977	0.00			0.00	0.00		
41	1976	0.00			0.00	0.00		
42	1975	0.00			0.00	0.00		
43	1974	0.00			0.00	0.00		
44	1973	0.00			0.00	0.00		
>44	1972	0.00			0.00	0.00		
Total		100%	100%		100%	100%	100%	

1 For conservative's sake, assuming all goods vehicles registered in 2009 to be of Euro IV standard.
2 For conservative's sake, assuming all goods vehicles registered in 2006 to be of Euro III standard
3 For detailed breakdown, see Tables 3 and 4.
4 Assuming the ratio in number of vehicle between HGV(7) and HGV(8) to be the same as that in 2003.

The composite idling emission factors for the assessment year are then calculated based on the composition of various engine types in the year corresponding to their emission factors. Table 6 presents a summary of the basic idling emission factors for different engine types.

Table 6: Basic Idling emission factors

Tier	Private Car		Heavy Goods Vehicle	
	NO_x (g/h)[1]	PM	NO_x(g/h)[2]	PM(g/h)[3]
Pre-Euro	1.0	Negligible	73.0	6.4
Euro I	1.0		61.3	3.52
Euro II	0.38		40.8	1.344
Euro III	0.27		27.5	0.896
Euro IV	0.14		18.0	0.448

Note:
[1] Source: Tables II.3-20 to II.3-27, Appendix 2 of "Road Tunnels: Vehicle Emission and Air Demand for Ventilation, PIARC, November 2004.
[2] Source: Tables II.3-46 to II.3-50, Appendix 2 of "Road Tunnels: Vehicle Emission and Air Demand for Ventilation, PIARC, November 2004.
3 Source: Tables II.3-52 to II.3-56, Appendix 2 of "Road Tunnels: Vehicle Emission and Air Demand for Ventilation, PIARC, November 2004. A conversion factor between particulate emission in g and turbidity is given by the MIRA-correlation factor 1g = 6.25m^2 (see page 21, **Attachment 2**).

According to Tables II.3-22, II.3-24 and II.3.26 of Appendix 2 of "Road Tunnels: Vehicle Emission and Air Demand for Ventilation, PIARC, November 2004, aging correction has to be applied to the private cars with gasoline engines. Table 7 shows the correction factors for various engine types.

Table 7: Aging correction factors for private cars with gasoline engines

	Euro I	Euro II	Euro III	Euro IV[2]
Correction factor[1]	3	1.82	2.0	2.0

Note:
1 Correction factors shown were only up to 2010 and will be adopted in the calculation.
2 No aging correction data for Euro 4 was available yet. In order to be on the safe side the Euro 3 aging correction has been applied.

Mass factors as shown in Table 8 will be applied to taken account of the mass variations in HGV. To maintain a safety margin, all HGV are assumed to be of 30t.

Table 8: Mass factor for HGV

	Pre-Euro and Euro I	Euro II, III and IV
NO_x	2.5	2.5
PM	2.6	2.3

Source: Table II.3-51, Appendix 2 to "Road Tunnels: Vehicle Emission and Air Demand for Ventilation, PIARC, November 2004.

The final calculated composite emission factors for the assessment year (say 2016) are shown in Table 9.

Table 9: Calculation of composite idling emission factors for 2016

Tier	Private Car			Heavy Goods Vehicle		
	% of population	Emission Standard		% of population	Emission Standard	
		NO_x (g/h)[3]	PM		NO_x (g/h)[4]	PM (g/h)[4]
Pre-Euro	0.3	1.0	Negligible	0.1	182.5	16.6
Euro I	0.1	3.0		0.1	153.25	9.15
Euro II	0.5	0.69		6.8	102	3.09
Euro III	9.2	0.54		37.1	68.75	2.06
Euro IV	90.1	0.28		19.3	45	1.03
Euro V[1]	0	0.28		36.5	45	1.03
Composite Emission Factor		0.31	Negligible		57.9	1.58
Composite Emission Factor considering China Fuel Usage[2] and A/C loading[5]		**0.42 (0.007g/min)**	**Negligible**		**79.04 (1.317g/min)**	**2.16 (0.036g/min)**

[1] There was no Euro V idling emission factor for NO_x, the same standard as Euro IV has been assumed for simplicity.
[2] With reference to the San Tin Interchange EIA (Register No.: AEIAR-077/2004), A factor of 1.05 has been applied to the idling emission factor for inclusion of China Fuel Usage.
[3] Aging corrections have been applied.
[4] Mass factors have been applied.
5 A factor of 1.3 has been applied to account for the additional A/C loading.

3. Conclusion

The idling emission factors of HGV presented above represent normal driving conditions taking into account various factors such as age distribution, maintenance conditions, China fuel usage and A/C loading. It is therefore consider appropriate to be adopted for assessing the vehicular emissions of the project. However, the idling emission factors of private car presented above are much lower than what has been adopted and are considered not representative of the local situation. The idling emission factor provided by EPD (0.2g/min for NOx) will therefore be adopted.

Attachment 1

Association
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TUNNELS ROUTIERS : ÉMISSIONS DES VÉHICULES ET BESOINS EN AIR POUR LA VENTILATION

ROAD TUNNELS: VEHICLE EMISSIONS AND AIR DEMAND FOR VENTILATION

Novembre / *November*
2004

Comité technique AIPCR de l'Exploitation des tunnels routiers (C5)
PIARC Technical Committee on Road Tunnel Operation (C5)

OXYDES D'AZOTE / NITROGEN OXIDES

Tableau / Table II.3-19
Coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission CEE 15/00

Nitrogen oxide basic emission factors for passenger cars
with gasoline engines to emission standard ECE 15/00

	Voitures essence, CEE 15/00, NOx / *PC-gasoline, CEE 15/00, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5	1.0	1.9	3.3	4.9	5.8	5.8	7.4
10	3.2	6.1	10.6	15.8	21.1	21.1	29.1
15	5.3	10.4	17.8	26.6	37.7	41.7	57.8
20	7.5	14.6	25.1	37.5	56.2	67.4	93.7
30	11.6	22.7	39.0	58.2	87.3	104.8	145.5
40	17.6	34.3	58.9	87.9	131.8	158.2	219.7
50	20.4	39.8	68.3	102.0	153.0	183.6	255.0
60	25.8	50.2	86.3	128.8	187.1	222.4	305.1
70	31.0	60.5	103.9	155.0	204.9	246.6	326.6
80	35.0	68.3	117.3	175.0	215.0	252.6	332.2
90	39.8	77.6	133.3	199.0	227.4	260.9	337.9
100	45.0	87.6	150.8	225.0	247.5	274.6	341.2
110	50.0	97.5	167.5	250.0	262.5	291.4	332.9
115	52.6	102.6	176.2	263.0	263.0	299.8	323.5

Tableau / *Table* II.3-20
Coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission pré-Euro (ECE 15/04)

Nitrogen oxide basic emission factors for passenger cars
with gasoline engines to emission standard pre-Euro (ECE 15/04)

	Voiture essence, pré-Euro, NOx / *PC-gasoline, pre-Euro*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5	1.0	2.0	3.4	5.0	6.0	6.0	7.6
10	2.4	4.7	8.1	12.0	16.1	16.1	22.3
15	3.8	7.4	12.7	19.0	27.0	29.9	41.4
20	5.2	10.1	17.4	26.0	39.0	46.8	65.0
30	7.6	14.8	25.5	38.0	57.1	68.5	95.1
40	11.2	21.8	37.5	56.0	84.0	100.8	140.0
50	13.2	25.6	44.1	65.8	98.6	118.4	164.4
60	18.2	35.5	61.0	91.0	132.3	157.2	215.7
70	23.2	45.3	77.9	116.2	153.6	184.9	244.8
80	30.0	58.6	100.6	150.2	184.5	216.8	285.1
90	41.0	79.9	137.2	204.8	234.0	268.5	347.7
100	52.6	102.5	176.2	262.9	289.2	320.9	398.8
110	65.0	126.7	217.7	325.0	341.2	378.8	432.7
115	72.2	140.8	241.9	361.0	361.0	411.5	444.0

Tableau / *Table* II.3-21
Coefficients d'émission de base pour les oxydes d'azote
pour voitures à essence conformes à la norme d'émission Euro 1
Nitrogen oxide basic emission factors for passenger cars emission standard Euro 1

	Voiture essence, Euro 1, NOx / *PC-gasoline, Euro 1, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
5	0.2	0.6	0.9	1.2	1.2	1.5	4.0
10	0.5	1.2	1.9	2.6	2.6	3.5	9.7
15	0.8	1.8	2.9	3.9	3.9	5.8	12.6
20	1.0	2.5	3.9	5.2	5.2	8.4	14.1
30	1.6	3.8	6.0	8.1	8.1	13.6	21.8
40	2.1	4.9	7.7	10.4	10.4	18.1	27.9
50	2.3	5.5	8.6	11.6	11.6	21.5	31.2
60	2.7	6.4	10.1	13.6	15.2	27.2	36.6
70	3.1	7.4	11.6	15.7	22.0	31.5	42.3
80	3.8	9.0	14.2	19.2	28.8	38.4	51.6
90	5.0	11.5	18.4	24.9	37.4	49.8	67.0
100	7.3	15.4	26.9	36.3	52.1	72.6	90.6
110	10.3	20.6	38.1	51.5	66.2	92.7	108.2
115	11.7	23.5	43.4	58.7	70.4	93.9	111.5

Tableau / *Table* II.3-22
Correction des coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission Euro 1
Nitrogen oxide basic emission factors for passenger cars emission standard Euro 1

	Coefficient de correction fa pour voiture essence, Euro 1, NOx Correction factor fa for PC-gasoline, Euro 1, NOx					
Année après mise en œuvre : Year after implementation	0 (1992)	2 (1994)	6 (1998)	10 (2002)	14 (2006)	18 (2010)
fa	1.0	1.2	1.7	2.1	2.5	3.0

Les années entre parenthèses ne sont valables que pour les pays de l'UE
The years given in brackets are valid for the EU countries only

Tableau / *Table* II.3-23
Coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission Euro 2
Nitrogen oxide basic emission factors for passenger cars emission standard Euro 2

	Voiture essence, Euro 2, NOx / *PC-gasoline, Euro 2, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	0.38	0.38	0.38	0.38	0.38	0.38	0.38
5	0.37	0.47	0.50	0.57	0.64	0.70	0.76
10	0.42	0.52	0.62	0.80	0.95	1.10	1.26
20	0.61	0.94	1.35	1.91	2.49	3.07	3.70
30	0.84	1.43	2.19	3.12	4.19	5.27	6.48
40	1.10	1.99	2.75	3.91	5.46	7.01	8.97
50	1.29	2.41	3.29	4.69	6.84	8.99	11.78
60	1.56	2.74	3.86	5.49	8.46	11.44	15.97
70	1.75	3.15	4.56	6.50	10.38	14.26	21.44
80	2.06	3.82	5.72	8.15	12.98	17.81	27.00
90	2.49	5.20	8.10	11.56	17.90	24.24	32.91
100	2.95	7.06	11.65	16.63	24.64	32.66	40.21
110	3.81	9.56	16.67	23.80	33.08	42.35	48.81
120	5.70	13.29	24.19	34.54	43.71	52.88	58.68
130	7.84	17.32	32.32	46.16	56.47	66.77	73.66

Tableau / *Table* II.3-24
Correction des coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission Euro 2
Correction of the Nitrogen oxide basic emission factors for passenger cars with gasoline engines to emission standard Euro 2

	Coefficient de correction pour voiture essence, Euro 2, NOx Correction factor fa for PC-gasoline, Euro 2, NOx					
Année après mise en œuvre / Year after implementation	3 (2000)	5 (2002)	7 (2004)	9 (2006)	11 (2008)	13 (2010)
fa	1.00	1.16	1.33	1.49	1.65	1.82

Les années entre parenthèses ne sont valables que pour les pays UE
The years given in brackets are valid for the EU countries only

Tableau / *Table* II.3-25
Coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission Euro 3
Nitrogen oxide basic emission factors for passenger cars emission standard Euro 3

	Voiture essence, Euro 3, NOx / *PC-gasoline, Euro 3, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	0.27	0.27	0.27	0.27	0.27	0.27	0.27
5	0.32	0.36	0.32	0.31	0.35	0.38	0.42
10	0.35	0.37	0.36	0.43	0.47	0.60	0.69
20	0.42	0.58	0.73	1.03	1.07	1.66	2.00
30	0.46	0.85	1.18	1.67	1.73	2.83	3.48
40	0.53	1.08	1.48	2.10	2.27	3.77	4.83
50	0.68	1.33	1.77	2.52	3.08	4.86	6.39
60	0.87	1.65	2.07	2.95	3.98	6.22	8.72
70	1.04	1.94	2.48	3.52	5.23	7.81	11.76
80	1.20	2.32	3.14	4.48	7.06	9.79	14.84
90	1.37	3.07	4.46	6.36	9.85	13.34	18.11
100	1.62	3.89	6.42	9.15	13.41	17.98	22.13
110	2.12	5.29	9.18	13.10	17.97	23.32	26.87
120	3.26	7.46	13.32	19.02	24.41	29.12	32.32
130	4.56	9.83	17.81	25.42	31.32	36.78	40.57

Tableau / *Table* II.3-26
Correction des coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission Euro 3
Correction of the Nitrogen oxide basic emission factors for passenger cars with gasoline engines to emission standard Euro 3

	Coefficient de correction fa pour voiture essence, Euro 3, NOx Correction factor fa for PC-gasoline, Euro 3, NOx					
Année après mise en œuvre / Year after implementation	0 (2001)	1 (2002)	4 (2004)	6 (2006)	8 (2008)	10 (2010)
fa	1.00	1.11	1.33	1.56	1.78	2.00

Les années entre parenthèses ne concernent que les pays de l'UE
The years given in brackets are valid for the EU countries only

Tableau / *Table* II.3-27
Coefficients d'émission de base pour les oxydes d'azote
pour les voitures à essence conformes à la norme d'émission Euro 4
Nitrogen oxide basic emission factors for passenger cars emission standard Euro 4

	Voiture essence, Euro 4, NOx / PC-gasoline, Euro 4, NOx						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	0.14	0.14	0.14	0.14	0.14	0.14	0.14
5	0.15	0.17	0.19	0.21	0.24	0.26	0.28
10	0.15	0.19	0.23	0.29	0.35	0.41	0.47
20	0.20	0.35	0.50	0.69	0.90	1.11	1.34
30	0.27	0.56	0.79	1.12	1.51	1.89	2.33
40	0.34	0.69	0.99	1.40	1.96	2.51	3.22
50	0.45	0.83	1.18	1.67	2.45	3.23	4.25
60	0.57	0.96	1.38	1.95	3.06	4.17	5.86
70	0.69	1.13	1.67	2.37	3.84	5.31	8.01
80	0.81	1.35	2.15	3.06	4.82	6.70	10.17
90	0.93	1.85	3.05	4.34	6.72	9.10	12.36
100	1.10	2.64	4.36	6.22	9.11	12.22	15.05
110	1.43	3.59	6.23	8.89	12.19	15.81	18.23
120	2.19	5.08	9.03	12.89	16.54	19.73	21.89
130	3.06	6.70	12.07	17.23	21.22	24.90	27.47

Pour les coefficients de base concernant les oxydes d'azote pour les voitures à essence conformes à la norme d'émission Euro 4, aucune correction de vieillissement n'est encore disponible. Afin d'être du côté de la sécurité, la correction de vieillissement Euro 3 devrait être appliquée.

For the nitrogen oxide basic emission factors for passenger cars with gasoline engines to emission standard Euro 4 no ageing correction data is available yet. In order to be on the safe side the Euro 3 aging correction should be applied.

Tableau / *Table* II.3-28
Coefficients d'émission de base pour les oxydes d'azote
pour les voitures diesel conformes à la norme d'émission pré-Euro (CEE 15/04)
Nitrogen oxide basic emission factors for passenger cars emission standard pre-Euro (CEE 15/04)

	Voiture diesel, pré-Euro, NOx / *PC-diesel, pre-Euro, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5	3.5	4.1	4.7	5.9	6.4	7.0	9.3
10	6.2	7.5	8.5	10.7	12.0	12.9	18.4
15	7.6	10.8	12.4	15.5	17.6	21.1	29.8
20	8.1	14.2	16.2	20.3	23.3	30.8	43.1
30	10.9	21.7	24.8	31.0	36.6	55.8	72.9
40	10.2	22.6	25.8	32.2	39.0	58.0	75.8
50	10.4	24.6	30.3	37.9	46.6	68.2	89.0
60	11.1	22.1	35.4	44.3	55.9	79.7	104.0
70	12.5	19.9	34.9	49.8	64.4	89.7	117.1
80	14.4	23.0	40.2	57.4	75.6	103.3	134.9
90	18.1	29.0	50.7	72.5	97.3	130.4	170.3
100	21.9	35.1	61.5	87.8	120.3	158.0	206.3
110	26.0	41.7	72.9	104.2	145.9	203.2	263.1
115	28.4	45.4	79.5	113.6	161.3	238.5	306.6

OXYDES D'AZOTE / *NITROGEN OXIDE*

Tableau / Table II.3-46
Coefficients d'émission de base pour les oxydes d'azote
pour les poids lourds et bus conformes à la norme d'émission pré-Euro (CEE 15/04)

Nitrogen oxide basic emission factors
for trucks and buses to emission standard pre-Euro (ECE 15/04)

	Poids lourd, pré-Euro, NOx / *HGV, 10t, pre-Euro, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	73.0	73.0	73.0	73.0	73.0	73.0	73.0
10	81.6	99.6	99.6	199.3	222.4	261.3	310.5
20	117.9	133.2	133.2	266.5	321.0	402.7	502.6
30	150.6	168.1	168.1	336.1	426.0	552.7	703.9
40	183.5	201.1	201.1	402.2	538.4	715.5	919.8
50	214.1	226.8	226.8	453.5	644.2	875.8	1134.6
60	245.0	264.3	264.3	528.5	773.7	1059.8	1373.1
70	283.8	304.2	304.2	608.3	913.5	1256.8	
80	322.7	342.5	342.5	685.0	1066.4	1475.1	

Tableau / Table II.3-47
Coefficients d'émission de base pour les oxydes d'azote
pour les poids lourds et bus conformes à la norme d'émission Euro 1

Nitrogen oxide basic emission factors
for trucks and buses to emission standard Euro 1

	Poids lourd, Euro 1, NOx / *HGV, 10t, Euro 1, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	61.3	61.3	61.3	61.3	61.3	61.3	61.3
5	64.5	68.5	68.5	137.1	145.7	161.4	181.9
10	68.5	83.7	83.7	167.4	186.8	219.5	260.8
20	99.0	111.9	111.9	223.9	269.6	338.3	422.2
30	126.5	141.2	141.2	282.3	357.8	464.3	591.3
40	154.1	168.9	168.9	337.8	452.3	601.0	772.6
50	179.8	190.5	190.5	380.9	541.1	735.7	953.1
60	205.8	222.0	222.0	443.9	649.9	890.2	1153.4
70	238.4	255.5	255.5	511.0	767.3	1055.7	
80	271.1	287.7	287.7	575.4	895.8	1239.1	

Tableau / *Table* II.3-48
Coefficients d'émission de base pour les oxydes d'azote
pour les poids lourds et bus conformes à la norme d'émission Euro 2

Nitrogen oxide basic emission factors
for trucks and buses to emission standard Euro 2

	Poids lourd, Euro 2, NOx / *HGV, 10t, Euro 2, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	40.8	40.8	40.8	40.8	40.8	40.8	40.8
5	43.6	47.9	53.1	64.8	72.0	80.0	88.8
10	46.7	52.7	60.2	76.6	95.0	117.3	148.6
20	53.5	63.6	76.2	103.9	145.8	194.5	275.5
30	61.2	76.4	95.4	137.1	203.5	286.0	429.7
40	70.1	89.8	114.4	168.5	266.5	399.5	614.8
50	80.2	103.9	133.6	198.8	335.0	531.3	836.9
60	91.9	119.6	154.3	230.6	417.8	681.4	1109.6
70	105.2	137.9	178.7	268.6	513.4	867.1	
80	120.4	160.3	210.1	319.7	630.0	1135.3	
90		186.5	247.3	381.0	779.4		
100		215.3	287.0	445.0			

Tableau / *Table* II.3-49
Coefficients d'émission de base pour les oxydes d'azote
pour les poids lourds et bus conformes à la norme d'émission Euro 3

Nitrogen oxide basic emission factors
for trucks and buses to emission standard Euro 3

	Poids lourd, Euro 3, Nox / *HGV, 10t,Euro 3, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	27.5	27.5	27.5	27.5	27.5	27.5	27.5
5	29.9	31.3	34.3	43.6	48.4	53.8	59.8
10	32.6	34.5	38.7	51.6	63.9	78.9	100.0
20	38.8	41.9	48.7	69.8	97.9	130.6	185.3
30	46.1	50.7	60.8	92.1	136.7	192.1	287.3
40	54.7	60.6	73.5	113.3	179.1	268.5	402.6
50	65.0	71.9	87.0	133.7	225.2	357.2	533.7
60	77.3	85.1	102.2	155.1	280.8	457.9	692.6
70	91.8	100.7	120.3	180.7	344.9	582.4	
80	109.1	119.7	143.0	215.1	423.2	762.1	
90		142.3	170.2	256.4	523.6		
100		168.5	200.5	299.5			

Tableau / *Table* II.3-50
Coefficients d'émission de base pour les oxydes d'azote
pour les poids lourds et bus conformes à la norme d'émission Euro 4

Nitrogen oxide basic emission factors
for trucks and buses to emission standard Euro 4

	Poids lourds, Euro 4, Nox / *HGV, 10t, Euro 4, NOx*						
[g/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
5	18.9	19.6	21.2	25.4	28.3	31.4	34.9
10	19.9	20.8	23.1	29.1	35.9	44.0	52.9
20	21.9	23.5	27.4	37.5	52.2	69.3	88.3
30	24.1	26.5	32.3	47.4	69.4	93.9	122.3
40	26.6	29.5	36.8	55.7	86.1	118.9	156.7
50	29.3	32.7	41.1	62.8	102.4	144.8	193.8
60	32.3	36.1	45.6	70.1	120.0	171.8	238.2
70	35.7	40.0	50.7	78.8	138.1	201.8	
80	39.3	44.4	57.3	90.7	159.7	243.0	
90		49.5	65.0	105.3	187.9		
100		55.1	73.4	120.8			

Tableau / *Table* II.3-51
Coefficient de masse fm pour NOx en fonction de la vitesse

Velocity dependent mass factor fm for NOx

	Coefficient de masse pour NOx en fonction de la vitesse / *Mass factor fm for NOx* Coefficient par rapport à un poids lourd de10 t / *proportion to a 10 t truck*					
v [km/h]	Pré-Euro & Euro 1			Euro 2, Euro 3 & Euro 4		
	10 t	20 t	30 t	10 t	20 t	30 t
0-50	1.0	1.8	2.5	1.0	2.0	2.5
60-100	1.0	1.6	2.1	1.0	2.1	2.7

OPACITÉ (PARTICULES PROVENANT DES ÉCHAPPEMENTS) / TURBIDITY (EXHAUST PM)

Tableau / Table II.3-52
Coefficients d'émission de base pour l'opacité
pour les poids lourds et bus conformes à la norme d'émission pré-Euro (CEE 15/04)
Turbidity basic emission factors for trucks and buses to emission standard pre-Euro (ECE 15/04)

	Poids lourd, pré-Euro, opacité / *HGV, 10t, pre-Euro, turbidity*						
[m²/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
5	42.1	44.3	44.3	88.6	90.5	94.0	98.6
10	44.3	47.7	47.7	95.3	99.7	106.9	116.0
20	51.1	53.9	53.9	107.8	118.0	133.2	151.8
30	57.1	60.4	60.4	120.8	137.5	161.1	189.2
40	63.3	66.5	66.5	133.1	158.4	191.4	229.4
50	69.0	71.3	71.3	142.6	178.1	221.2	269.3
60	74.7	78.3	78.3	156.6	202.2	255.4	313.7
70	81.9	85.7	85.7	171.4	228.2	292.0	
80	89.2	92.9	92.9	185.7	256.6	332.7	

Tableau / *Table II*.3-53
Coefficients d'émission de base pour l'opacité
pour les poids lourds et bus conformes à la norme d'émission Euro 1
Turbidity basic emission factors for trucks and buses to emission standard Euro 1

	Poids lourd, Euro 1, opacité / *HGV, Euro 1, turbidity*						
[m²/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
5	23.1	24.4	24.4	48.7	49.8	51.7	54.2
10	24.4	26.2	26.2	52.4	54.8	58.8	63.8
20	28.1	29.6	29.6	59.3	64.9	73.3	83.5
30	31.4	33.2	33.2	66.4	75.6	88.6	104.1
40	34.8	36.6	36.6	73.2	87.1	105.3	126.2
50	38.0	39.2	39.2	78.4	98.0	121.7	148.1
60	41.1	43.1	43.1	86.1	111.2	140.5	172.5
70	45.0	47.1	47.1	94.3	125.5	160.6	
80	49.1	51.1	51.1	102.1	141.1	183.0	

Tableau / *Table* II.3-54
Coefficients d'émission de base pour l'opacité
pour les poids lourds et bus conformes à la norme d'émission Euro 2
Turbidity basic emission factors for trucks and buses to emission standard Euro 2

	Poids lourds, Euro 2, opacité / *HGV, Euro 1, turbidity*						
[m²/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	8.4	8.4	8.4	8.4	8.4	8.4	8.4
5	16.5	9.3	9.4	9.5	10.4	11.6	13.0
10	9.9	10.1	10.2	10.3	12.2	14.5	17.2
20	11.4	11.7	12.0	12.3	15.8	20.2	25.4
30	12.3	13.1	13.9	14.7	19.7	25.8	33.2
40	13.0	14.3	15.7	17.1	23.3	31.1	40.4
50	13.3	15.3	17.3	19.2	26.8	36.2	47.5
60	13.6	16.2	18.8	21.3	30.4	41.8	55.5
70	14.8	17.7	20.5	23.4	34.2	47.7	
80	17.2	20.6	23.9	27.3	41.1	58.5	
90		24.8	29.1	33.3	53.0		
100		30.8	36.0	40.5			

Tableau / *Table* II.3-55
Coefficients d'émission de base pour l'opacité
pour les poids lourds et bus conformes à la norme d'émission Euro 3
Turbidity basic emission factors for trucks and buses to emission standard Euro 3

	Poids lourd, Euro 3, opacité / *HGV, Euro 3, turbidity*						
[m²/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	5.6	5.6	5.6	5.6	5.6	5.6	5.6
5	6.1	6.2	6.2	6.3	6.9	7.7	8.7
10	6.6	6.7	6.8	6.9	8.1	9.6	11.5
20	7.6	7.8	8.0	8.2	10.5	13.5	17.0
30	8.3	8.8	9.3	9.8	13.1	17.3	22.2
40	8.7	9.6	10.5	11.4	15.6	20.9	27.2
50	9.0	10.3	11.5	12.8	18.0	24.5	32.3
60	9.2	10.9	12.6	14.2	20.6	28.5	38.1
70	10.0	11.9	13.8	15.6	23.2	32.8	
80	11.7	13.9	16.0	18.2	28.1	40.4	
90		16.7	19.5	22.3	36.3		
100		20.7	24.1	27.0			

Tableau / *Table* II.3-56
Coefficients d'émission de base pour l'opacité
pour les poids lourds et bus conformes à la norme d'émission Euro 4
Turbidity basic emission factors for trucks and buses to emission standard Euro 4

	Poids lourd, Euro 4, opacité / *HGV, Euro 4, turbidity*						
[m²/h]	Pente / *Gradient* [%]						
v [km/h]	-6	-4	-2	0	2	4	6
0	2.8	2.8	2.8	2.8	2.8	2.8	2.8
5	3.1	3.1	3.1	3.2	3.5	3.9	4.3
10	3.3	3.4	3.4	3.4	4.1	4.8	5.7
20	3.8	3.9	4.0	4.1	5.3	6.7	8.5
30	4.1	4.4	4.7	4.9	6.6	8.6	11.1
40	4.3	4.8	5.3	5.7	7.8	10.4	13.6
50	4.5	5.1	5.8	6.4	9.0	12.3	16.1
60	4.6	5.5	6.3	7.1	10.3	14.3	19.0
70	5.0	6.0	6.9	7.8	11.6	16.4	
80	5.9	6.9	8.0	9.1	14.0	20.2	
90		8.4	9.7	11.1	18.2		
100		10.4	12.1	13.5			

Tableau / *Table* II.3-57
Coefficient de masse fm pour l'opacité en fonction de la vitesse
Velocity dependent mass factor fm for turbidity

	Coefficient de masse fm pour l'opacité Coefficient par rapport à un poids lourd de 10 t * / *Mass factor fm for turbidity* *proportion to a 10t-truck **					
v [km/h]	pré-Euro et Euro 1			Euro 2, Euro 3 et Euro 4		
	10 t	20 t	30 t	10 t	20 t	30 t
0-50	1.0	1.8	2.6	1.0	1.9	2.3
60-100	1.0	1.6	2.1	1.0	1.9	2.6

* Emissions de l'échappement uniquement ; pas de coefficient de masse disponible pour les autres émissions
* Tail pipe emissions only; no mass dependent emission factor for non-exhaust emissions available