

## Appendix 2.3 - Heavy Metal Exhaust Emissions From Mobile Sources

### Road Transport

For heavy-metal exhaust emissions (other than lead from leaded gasoline), tier1 values have been derived from tier1 default values provided in the 2019 EMEP/EEA Guidebook.

Table 1: Tier1 default emission factors applied to road vehicles, in [g/TJ]

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
<b>Diesel oil</b>	0.012	0.001	0.123	0.002	0.198	0.133	0.005	0.002	0.419
<b>Biodiesel<sup>1</sup></b>	0.013	0.001	0.142	0.003	0.228	0.153	0.005	0.003	0.483
<b>Gasoline fuels</b>	0.051	2.10	0.196	0.007	8.96	357	14.7	2.09	208
<b>CNG</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE
<b>LPG</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE
<b>Biogas</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE

<sup>1</sup> values differ from EFs applied for fossil diesel oil to take into account the specific NCV of biodiesel

The 2019 GB provides separate values for Hm from fuel combustion (including engine wear) and the unintended co-incineration of lube oil. The latter are reported in NFR 2.D as emissions from product use. (Note: This country-specific approach has been discussed and accepted at both the 2018 TFEIP meeting and the 2018 NEC review.)

Table 3-78: Heavy metal emission factors for all vehicle categories in ppm/wt fuel

Category	Pb	Cd	Cu	Cr	Ni	Se	Zn	Hg	As
Passenger cars, petrol	0.0016	0.0002	0.0045	0.0063	0.0023	0.0002	0.033	0.0087	0.0003
Passenger cars, diesel	0.0005	5 E-05	0.0057	0.0085	0.0002	0.0001	0.018	0.0053	0.0001
LCVs, petrol	0.0016	0.0002	0.0045	0.0063	0.0023	0.0002	0.033	0.0087	0.0003
LCVs, diesel	0.0005	5 E-05	0.0057	0.0085	0.0002	0.0001	0.018	0.0053	0.0001
HDVs, petrol	0.0016	0.0002	0.0045	0.0063	0.0023	0.0002	0.033	0.0087	0.0003
HDVs, diesel	0.0005	5 E-05	0.0057	0.0085	0.0002	0.0001	0.018	0.0053	0.0001
L-category	0.0016	0.0002	0.0045	0.0063	0.0023	0.0002	0.033	0.0087	0.0003

Table 3-79: Heavy metal emission factors for all vehicle categories in ppm/wt lubricant

Category	Pb	Cd	Cu	Cr	Ni	Se	Zn	Hg	As
Passenger cars, petrol	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0
Passenger cars, diesel	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0
LCVs, petrol	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0
LCVs, diesel	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0
HDVs, petrol	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0
HDVs, diesel	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0
L-category	0.0332	4.56	778	19.2	31.89	4.54	450.2	0	0

### Non-road Mobile Machinery in 1.A.2.g vii, 1.A.4.a.ii, 1.A.4.b.i, 1.A.4.c.ii



	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
<b>Diesel oil</b>	1.21	0.233	0.123	0.002	1.16	39.6	1.63	0.233	23.3
<b>Biodiesel<sup>1</sup></b>	0.013	0.001	0.142	0.003	0.23	0.15	0.005	0.003	0.48

<sup>1</sup> similar EF for biodiesel applied for all mobile sources

## Maritime Vessels and Ships in 1.A.3.d i, 1.A.3.d ii, 1.A.4.c iii and 1.A.5.b iii

The following table provides the tier1 EF applied for HMs from ships and vessels in both civil and military operation in NFR categories 1.A.3.d i -International Maritime Navigation, 1.A.3.d ii - National Navigation (Shipping), 1.A.4.c iii -Fishery and 1.A.5.b iii - Other: Military Navigation.

Table 4: Tier1 default emission factors applied to maritime ships and vessels in g/TJ

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
<b>Heavy Fuel oil<sup>1</sup></b>	4.46	0.50	0.50	16.9	17.8	31.0	793	5.20	29.7
<b>Diesel oil<sup>2</sup></b>	3.03	0.23	0.70	0.93	1.16	20.5	23.3	2.33	27.9
<b>Biodiesel<sup>3</sup></b>	0.013	0.0013	0.142	0.003	0.23	0.15	0.005	0.003	0.48

<sup>1</sup> tier1 defaults from <sup>4)</sup>, Chapter: 1.A.3.d.i, 1.A.3.d.ii, 1.A.4.c.iii Navigation: Table 3-1

<sup>2</sup> tier1 defaults from <sup>5)</sup>, Chapter: 1.A.3.d.i, 1.A.3.d.ii, 1.A.4.c.iii Navigation: Table 3-2

<sup>3</sup> similar EF for biodiesel applied for all mobile sources (*NOTE: Assuming that biodiesel contains far less HMs than fossil diesel oil, similar values are applied to all mobile sources using this biogenic fuel.*)

## Aircraft in 1.A.3.a and 1.A.5.b ii

The EMEP/EEA GB 2019 does not provide specific defaults for HM emissions from the combustion of jet kerosene and aviation gasoline, stating that for aviation gasoline these emissions are *not estimated* (NE):

[gallery size="medium" : GB2016\(July2017\)\\_EF\\_NA+NE\\_Avgas.PNG gallery](#)

Therefore, the inventory compiler decided to apply the tier1 EF from gasoline fuel used in non-road mobile machinery here, too. Although the Party assumes that HM emissions are also likely to occur from the combustion of jet kerosene, no gap-filling is carried out for this fuel. Instead, all HM emission from jet kerosene are reported as *not estimated* (NE).

Table 5: Tier1 default emission factors applied to aircraft, in g/TJ

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
<b>Kerosene</b>	NE								
<b>Aviation gasoline</b>	9,481 <sup>1</sup>	0.005	0.200	0.007	0.145	0.103	0.053	0.005	0.758

<sup>1</sup> estimated from average lead content of AvGas 100 LL (see also: 1.A.3.a ii (i) and FAQs) of 0.56 g Pb/liter

1), 2), 3), 4), 5) EMEP/EEA, 2019: EMEP/EEA air pollutant emission inventory guidebook 2019; Copenhagen, 2019.