

1.A.3.a ii (i) - Domestic Civil Aviation: LTO

Short description

In NFR category *1.A.3.a ii (i) - Domestic Civil Aviation: LTO* emissions from domestic flights between German airports occurring during LTO stage (Landing/Take-off: 0-3,000 feet) are reported.

Method	AD	EF	Key Category
T1, T2, T3	NS, M	CS, D, M	no key category

T = key source by Trend **L** = key source by Level

Methods	
D	Default
RA	Reference Approach
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/CORINAIR Emission Inventory Guidebook - 2007, in the group specific chapters.	
AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
AS	Associations, business organisations
Q	specific questionnaires, surveys
EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data

In the following, information on sub-category specific AD, (implied) emission factors and emission estimates are provided.

Methodology

Activity Data

NH₃														
NMVOC														
NO_x														
SO_x														
BC¹														
PM²														
TSP³														
CO														

¹ estimated via a f-BCs (avgas: 0.15, jet kerosene: 0.48) as provided in ⁸⁾

² EF(PM₁₀,2.5,,) also applied for PM₁₀, and TSP (assumption: > 99% of TSP from diesel oil combustion consists of PM₁₀,2.5,,)

³ also including TSP from lead: EF(TSP) = 1.6 x EF(Pb) - see road transport



For the country-specific emission factors applied for particulate matter, no clear indication is available, whether or not condensables are included.

Table 4: Tier1 emission factors for heavy-metal and POP exhaust emissions

	= Pb	= Cd	= Hg	= As	= Cr	= Cu	= Ni	= Se	= Zn	= B[a]P	= B[b]F	= B[k]F	= I[...]	= PAH 1-4	= PCDD/F			
=	= [g/T]									= [mg/T]				= [mg/T]	= [μg/T]			
~ Kerosene	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE	= NE			
~ Aviation gasoline	> 9,481	1		> 0.005	> 0.200	> 0.007	> 0.145	> 0.103	> 0.053	> 0.005	> 0.758	> 126	> 182	> 90	> 205	> 602	= NE	
1																		

NFR 1.A.3.a ii (i) - Domestic Civil Aviation - LTO is **no key source**.

Where **sulphur oxides** emissions are dominated by jet kerosene due to the amount of fuel used, the majority of **carbon monoxide** stems from the consumption of avgas given the much higher emission factor applied to this fuel.

[gallery size="medium" : 1A3aii\(i\)_SOx.png : 1A3aii\(i\)_CO.png](#) [gallery](#)

Lead emissions on the other hand, with no emission factor available for jet kerosene, are only calculated for avgas.

[gallery size="medium" : 1A3aii\(i\)_Pb.png](#) [gallery](#)

Recalculations

Activity data

~ Submission 2020	> 203	> 201	> 254	> 262	> 260	> 255	> 250	> 240	> 240	> 234	> 232	> 238	> 241	> 246	> 238	> 238
~ Submission 2019	> 182	> 184	> 238	> 254	> 255	> 248	> 240	> 226	> 217	> 215	> 210	> 212	> 214	> 206	> 201	> 199
~ absolute change	> 21.2	> 17.1	> 16.4	> 7.80	> 5.58	> 6.22	> 9.74	> 14.0	> 23.0	> 19.0	> 21.8	> 25.6	> 27.3	> 39.7	> 36.7	> 39.1
~ relative change	> 11.6%	> 9.3%	> 6.9%	> 3.1%	> 2.2%	> 2.5%	> 4.1%	> 6.2%	> 10.6%	> 8.9%	> 10.3%	> 12%	> 12.7%	> 19.2%	> 18.3%	> 19.7%

Furthermore, all country-specific emission factors applied for aviation gasoline have been revised widely based on better knowledge but with no significant impact on the emission inventory.

Table 7: Revised country-specific emission factors for aviation gasoline, in [kg/TJ]

< NMVOC																
~ Submission 2020	> 612	> 622	> 608	> 616	> 614	> 612	> 612	> 615	> 612	> 622	> 619	> 621	> 619	> 618	> 619	> 614
~ Submission 2019	> 181	> 182	> 179	> 177	> 175	> 174	> 177	> 178	> 180	> 186	> 186	> 186	> 184	> 183	> 187	> 187
~ absolute change	> 431	> 440	> 429	> 439	> 439	> 437	> 435	> 436	> 432	> 436	> 433	> 435	> 434	> 435	> 432	> 426
~ relative change	> 238%	> 242%	> 239%	> 248%	> 250%	> 251%	> 245%	> 245%	> 241%	> 235%	> 233%	> 234%	> 235%	> 237%	> 231%	> 228%
< Nitrogen oxides - NO_x																
~ Submission 2020	> 126	> 128	> 125	> 126	> 125	> 125	> 125	> 125	> 124	> 128	> 127	> 128	> 127	> 126	> 127	> 125
~ Submission 2019	> 279	> 275	> 284	> 292	> 298	> 301	> 291	> 287	> 283	> 263	> 262	> 261	> 266	> 270	> 257	> 257
~ absolute change	> -153	> -147	> -159	> -166	> -173	> -176	> -166	> -162	> -159	> -135	> -135	> -133	> -139	> -144	> -129	> -131
~ relative change	> -54.8%	> -53.4%	> -56.0%	> -56.8%	> -58.0%	> -58.6%	> -56.9%	> -56.3%	> -56.1%	> -51.4%	> -51.4%	> -51.1%	> -52.3%	> -53.3%	> -50.4%	> -51.2%
< Sulphur oxides - SO_x																
~ Submission 2020	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46
~ Submission 2019	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51	> 0.51
~ absolute change	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05	> -0.05
~ relative change	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%	> -9.5%
< Black carbon - BC																
~ Submission 2020	> 1.12	> 1.13	> 1.12	> 1.18	> 1.16	> 1.16	> 1.12	> 1.17	> 1.18	> 1.14	> 1.12	> 1.13	> 1.12	> 1.16	> 1.11	> 1.05
~ Submission 2019	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07	> 0.07
~ absolute change	> 1.05	> 1.06	> 1.05	> 1.11	> 1.09	> 1.09	> 1.05	> 1.10	> 1.11	> 1.07	> 1.06	> 1.06	> 1.05	> 1.09	> 1.04	> 0.98
~ relative change	> 1521%	> 1536%	> 1527%	> 1616%	> 1580%	> 1585%	> 1529%	> 1600%	> 1616%	> 1547%	> 1532%	> 1538%	> 1525%	> 1583%	> 1508%	> 1428%

< Particulate matter - PM																	
~ Submission 2020	> 7.45	> 7.52	> 7.48	> 7.89	> 7.72	> 7.74	> 7.49	> 7.81	> 7.89	> 7.57	> 7.50	> 7.53	> 7.47	> 7.73	> 7.39	> 7.02	
~ Submission 2019	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	> 0.46	
~ absolute change	> 6.99	> 7.06	> 7.02	> 7.43	> 7.26	> 7.28	> 7.03	> 7.35	> 7.43	> 7.11	> 7.04	> 7.07	> 7.01	> 7.27	> 6.93	> 6.57	
~ relative change	> 1521%	> 1536%	> 1527%	> 1616%	> 1580%	> 1585%	> 1529%	> 1600%	> 1616%	> 1547%	> 1532%	> 1538%	> 1525%	> 1583%	> 1508%	> 1428%	
< Carbon monoxide - CO																	
~ Submission 2020	> 20,728	> 21,069	> 20,855	> 20,973	> 21,124	> 21,248	> 21,122	> 21,229	> 21,326	> 21,339	> 21,463	> 21,389	> 21,513	> 21,555	> 21,468	> 21,944	
~ Submission 2019	> 14,951	> 15,047	> 14,832	> 14,644	> 14,479	> 14,421	> 14,648	> 14,750	> 14,853	> 15,354	> 15,384	> 15,406	> 15,269	> 15,174	> 15,502	> 15,503	
~ absolute change	> 5,777	> 6,022	> 6,023	> 6,329	> 6,645	> 6,827	> 6,474	> 6,479	> 6,473	> 5,985	> 6,079	> 5,983	> 6,244	> 6,381	> 5,966	> 6,441	
~ relative change	> 38.6%	> 40.0%	> 40.6%	> 43.2%	> 45.9%	> 47.3%	> 44.2%	> 43.9%	> 43.6%	> 39.0%	> 39.5%	> 38.8%	> 40.9%	> 42.1%	> 38.5%	> 41.5%	



For more information on recalculated emission estimates for Base Year and 2018, please see the pollutant specific recalculation tables following chapter [8.1 - Recalculations](#).

Uncertainties

For uncertainties information, please see [main chapter](#) on civil aviation.

Planned improvements

For information on planned improvements, please see [main chapter](#) on civil aviation.

FAQs

Why are emissions from aviation gasoline reported using a Tier 1 approach whereas for jet kerosene Tier 2a has been applied?

For reporting emissions from the consumption of jet kerosene, the party uses an annual split factor provided by Eurocontrol to divide the total amount of kerosene used (from Energy Balances & Official oil data for the Federal Republic of Germany) onto national and international civil aviation. For aviation gasoline, such split factor does not exist. - Furthermore, the deviation of kerosene used onto flight stages LTO and Cruise has been carried out using data on numbers of take-offs from German airports provided by the German Federal Statistical Office. At the moment, such data is not available

for aircraft using aviation gasoline.

On which basis does the party estimate the reported lead emissions from aviation gasoline?

assumption by party: aviation gasoline = AvGas 100 LL (AvGas 100 LL is the predominant sort of aviation gasoline in Western Europe)^{footnote} <https://en.wikipedia.org/wiki/Avgas> : "...Common in North America and western Europe, limited availability elsewhere worldwide." ^{footnote} lead content of AvGas 100 LL: 0.56 g lead/liter (as tetra ethyl lead)^{footnote} EMEP/EEA GB 2016: "Thus, general emission factors for the stationary combustion of kerosene and the combustion of gasoline in cars may be applied. The only exception is lead. Lead is added to aviation gasoline to increase the octane number. The lead content is higher than in leaded car gasoline, and the maximum permitted levels in the UK are shown below. A value of 0.6 g of lead per litre of gasoline should be used as the default value if there is an absence of more accurate information. Actual data may be obtained from oil companies."^{footnote}

The applied procedure is similar to the one used for calculating lead emissions from leaded gasoline used in road transport. (There, in contrast to aviation gasoline, the lead content constantly declined resulting in a ban of leaded gasoline in 1997.)

On which basis does the party estimate the reported TSP emissions from aviation gasoline?

The TSP emissions calculated depend directly on the reported lead emissions: The emission factor for TSP is 1.6 times the emission factor used for lead: $EF(TSP) = 1.6 \times EF(Pb)$. The applied procedure is similar to the one used for calculating TSP emissions from leaded gasoline used in road transport.

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Advanced emission model (AEM); <https://www.eurocontrol.int/model/advanced-emission-model>; 2019
bibliography

¹⁾ (bible 2)

²⁾ (bible 3)

³⁾ (bible 2)

⁴⁾ (bible 3)

⁵⁾ (bible 1)

- ⁶⁾ (bibcite 2)
- ⁷⁾ (bibcite 4)
- ⁸⁾ (bibcite 4)
- ⁹⁾ (bibcite 4)
- ¹⁰⁾ (bibcite 5)