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Transport and Environment: Vessels, aircrafts, trains and lorries – equal treatment before the law in view of their environmental impact?

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National Report of Germany

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PART A: LEGISLATION FOR MEANS OF TRANSPORT REGARDING EMISSIONS

I. Introduction

Most goods are by far – at least within Germany – transported on roads, followed by rail transportation and transportation by inland waterway vessels:

	Unit	2011	2012	2013	2014
Quantities carried					
Rail transport	1,000 tonnes	374,737	366,14	373,738	365,003
Inland water transport	1,000 tonnes	221,966	223,17	226,864	228,489
Sea transport	1,000 tonnes	292,788	295,103	293,999	300,12
Air transport	1,000 tonnes	4,436	4,317	4,315	4,396
Road goods transport[2]	1,000 tonnes	3,390,500	3,306,700	3,366,700	3,493,100

[2]German and foreign lorries; source: German Institute for Economic Research (DIW), Intraplan

Out of those means of transport, concerning emissions – i.e. air pollution for the purposes of this report –, transportation by road accounts for the largest share of greenhouse gas emissions in Germany with regard to the transport sector.[1] Current projections even expect an increase in the use of heavy-duty vehicles (HDV > 3.5 t GVW) by 30 % until 2030.

Approx. since the 1970s a number of measures – mostly on a European level – have been taken in particular to reduce greenhouse gas emissions of heavy duty vehicle (HDV). Since the 1990s further measures have been implemented with regard to the other means of transport. All of those measures have in particular two aspects in common:

- They set out admissible limit values as regards emissions for the engines used in the respective means of transport.

- They set out requirements as regards the composition of fuels used in the respective engines. Here a particular focus is on the limitation of sulfur in fuel.

In the following, this report provides a broad outline of the laws, regulations and administrative rules governing the normal operation of vessels, aircrafts, trains and HDV with respect to emissions. It does not claim to provide an exhaustive list of those laws, regulations and administrative guidelines applicable.

[1] Cf. Publication of the Umweltbundesamt of April 2015: "Future measures for fuel savings and GHG reduction of heavy-duty vehicles", available at: http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_32_2015_summary_future_measures_for_fuel_savings.pdf.

II. By which national rules is the normal operation of vessels, aircrafts, trains and lorries with respect to emissions governed?

Applicable rules in general as regards emissions

In Germany, there does not exist just one code regulating the operation of means of transport with regard to their emissions. On the contrary, rules are spread over a number of laws, regulations as well as administrative guidelines.

A central law regulating broadly the emissions of means of transport in Germany is the Federal Immission Protection Law (Bundes-Immissionsschutzgesetz). § 38 Federal Immission Protection Law provides in general for vehicles, railway vehicles, vessels and aircrafts that they have to be:

- designed in such a way that they only generate emissions up to a certain limit value;

- operated in such a way that avoidable emissions are prevented and that unavoidable emissions are limited to a minimum.

Those requirements have been defined by further laws, regulations and administrative guidelines. They are to a comprehensive extent governed by directives and regulations of the European Union. An exception to this is the operation of seagoing vessels and aircrafts which are to a large extent not governed by acts of the European Union but by international rules issued by the International Maritime Organisation and the International Civil Aviation Organization.

Heavy-duty vehicles (in the following "HDV")

1. General

   In addition to the Federal Immission Protection law referred to above, in particular the following laws and regulations are applicable to the operation of HDV in Germany:

   - Road Transport Law (Straßenverkehrsgesetz);
   - Road Traffic Regulation (Straßenverkehrsordnung);
   - Regulation Authorizing the Use of Vehicles for Road Traffic (Straßenverkehrszulassungsordnung);
   - Regulation Authorizing the Use of Vehicles (Fahrzeugzulassungs-Verordnung).

Based on those laws and regulation a number of further regulations and administrative guidelines have been issued.

2. Emission limits as regards engines used in HDV

The specific laws and regulations referred to above provide in general that HDV can only be operated on roads in Germany if they have an authorization from the German authorities to do so. One requirement that needs to be fulfilled in order to receive such authorization concerns the engine used in the respective HDV. Such engine has to fulfill certain limit values as regards its emissions. Those limit values have been constantly defined by the European Union since the beginning of the 1980s. To date about seven different limit values have been defined.

In general

§ 47 of the Regulation Authorizing the Use of Vehicles for Road Traffic

provides that HDV have at least to fulfill the limit values set out in

Council Directive 88/77/EEC of 3 December 1987 on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous pollutants from diesel engines for use in vehicles

in order to be operated in Germany.

The limit values set out in Directive 88/77/EEC have been further defined by directives and regulations of the European Union. They are generally known as EURO I – VI and may be different for positive ignition engines and diesel engines. Those limit values have been adopted by the following directives and regulations:

- Council Directive 91/542/EEC of 1 October 1991 amending Directive 88/77/EEC on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous pollutants from diesel engines for use in vehicles (EURO I and II);

- Directive 1999/96/EC of the European Parliament and of the Council of 13 December 1999 on the approximation of the laws of the Member States relating to measures to be taken against the emission of gaseous and particulate pollutants from compression ignition engines for use in vehicles, and the emission of gaseous pollutants from positive ignition engines fueled with natural gas or liq-

uefied petroleum gas for use in vehicles and amending Council Directive 88/77/EEC (EURO III, IV and V);

- Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information and amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC (EURO VI).

With the adoption of Regulation (EC) No 595/2009 a limit value for the admissible number of particles was implemented for the first time. The limit values set out in Regulation (EC) No 595/2009 were adapted to the technical standards by:

- Commission Regulation (EU) No 582/2011 of 25 May 2011 implementing and amending Regulation (EC) No 595/2009 of the European Parliament and of the Council with respect to emissions from heavy duty vehicles (Euro VI) and amending Annexes I and III to Directive 2007/46/EC of the European Parliament and of the Council; and

- Commission Regulation (EU) No 133/2014 of 31 January 2014 amending, for the purposes of adapting to technical progress as regards emission limits, Directive 2007/46/EC of the European Parliament and of the Council, Regulation (EC) No 595/2009 of the European Parliament and of the Council and Commission Regulation (EU) No 582/2011.

All of those directives and regulations are applicable in Germany and have been implemented by amendment of different regulations such as

- Regulation for the Approval of Vehicles (Fahrzeuggenehmigungsverordnung); and

- Regulation Authorizing the Use of Vehicles for Road Traffic.

As regards the applicability of the respective limit values, their applicability depends on the date authorization is granted for the first time. Thereby, whether an engine

fulfills the relevant limit values is inter alia established by a framework procedure and can be established for certain type of HDV. To that extent

> Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles

was adapted. At the end of the process, a "Certificate of Conformity" will be issued proofing that the respective limit values are met.

In Germany, Directive 2007/46/EC was inter alia implemented by the Regulation Authorizing the Use of Vehicles and the Regulation Authorizing the Use of Vehicles for Road Traffic mentioned above.

With regard to HDV placed on the market for the first time in 2014 or after as regards the framework procedure the following limit values need to be met:

	Limits values (EURO VI)							
	CO (g/kWh)	THC (g/kWh)	NMHC (g/kWh)	CH_4 (g/kWh)	NO_X (g/kWh)	NH_3 (ppm)	PM mass (g/kWh)	PM number (amount /kWh)
WHSC (CI)	1.5	0.13	-	-	0.4	10	0.01	8.0×10^{11}
WHTC (CI)	4.0	0.16	-	-	0.46	10	0.01	6.0×10^{11}
WHTC (PI)	4.0	-	0.16	0.5	0.46	10	0.01	(2) 6.0×10^{11}

Source: Regulation (EU) No 133/2014

Note:
PI = Positive Ignition
CI = Compression Ignition (diesel engines)
WHSC = World Harmonized Stationary Cycle
WHTC = World Harmonized Transient Cycle
(2) The limit shall apply as from the dates set out on row B of Table 1 of Appendix 9 of Annex 1 to Regulation (EU) No 582/2011

3. Composition of fuel

Moreover, in order to further reduce emissions, it has been regulated how the fuel has to be composed of used in HDV. The admissible composition was again defined by directives of the European Union, inter alia:

- Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC; and

- Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the Sulphur content of certain liquid fuels and amending Directive 93/12/EEC.

Those directives were implemented into German law by the 10th Regulation to the Federal Immission Protection Law.

The 10th Regulation to the Federal Immission Protection Law distinguishes between different types of fuel – i.e. fuel for positive ignition engines and diesel engines – split for the different means of transport. With regard to HDV as regards Sulphur in fuel the 10th Regulation to the Federal Immission Protection Law regulates that the amount of Sulphur in fuel for gasoline and diesel fuel shall not exceed 0.01 g/kg.

4. Operation of HDV

Even where authorized to be operated on roads in Germany, HDVs have to be operated in a certain way.

- In general, HDVs have to be operated in Germany in such a way that avoidable greenhouse gas emissions are prevented.

  This is regulated in § 38 Federal Immission Protection Law mentioned above and in § 30 Road Traffic Regulation. § 30 Road Traffic Regulation also provides that it is prohibited to operate HDVs > 7.5 t GVW on Sundays and on public holidays.

- Moreover, in so called Low-Emission Zones only HDV can be operated that fulfill certain emission limit values. Since 1 November 2015 there have been 50 Low-Emission Zones in place in Germany.[2]

  The framework for those Low-Emission Zones was established by:

  - Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management; and

[2] Cf.: website of the Umweltbundesamt, available at: http://www.umweltbundesamt.de/themen/luft/luftschadstoffe/feinstaub/umweltzonen-in-deutschland.

- Council Directive 1999/30/EC of 22 April 1999 relating to limit values for Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air; and

- Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe.

Those directives have been in particular implemented by the enactment of the 39th Regulation to the Federal Immission Protection Law.

The limit values HDV have to fulfill in order to be allowed to operate in a Low-Emission Zone are different and depend on the relevant Low-Emission Zone. However, the possible limit values are oriented towards the directives and regulations mentioned above, i.e. EURO I – VI.

5. Taxation

In Germany a vehicle owner has to pay a tax for the operation of such vehicle, accordingly also for the operation of a HDV. Details are inter alia regulated in the Motor Vehicle Tax Act ("Kraftfahrzeugsteuer-Gesetz"). Thereby, the amount of tax payable depends on the greenhouse gas emission the respective HDV produces. Again, the limit values for the calculation of the tax depend – broadly speaking – on the limit values set out in the directives and regulations set out above, i.e. EURO I - VI.

Railway vehicles

Unlike HDV the biggest concern as regards emissions of railway vehicles are not greenhouse gas emissions but particle emissions.[3]

1. General

In addition to the Federal Immission Protection law referred to above, in particular the following laws and regulations are applicable to the operation of railway vehicles in Germany:

- General Railways Act (Allgemeines Eisenbahngesetz);

[3] Cf. Publication of the Umweltbundesamt of December 2013, available at: https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_24_2014_erarbeitung_eines_konzepts_zur_minderung_der_umweltbelastung_aus_nrmm.pdf.

- Railway Construction and Operations Regulation (Eisenbahn-Bau- und Betriebsordnung).

Based on those laws and regulation a number of further regulations and administrative guidelines have been issued.

2. Emission limits as regards compression ignition (diesel) engines used in railway vehicles

Like HDV also railway vehicles can only be operated in Germany if they have authorization to do so. § 4 General Railways Act and § 2 of Regulation for the Operation and Construction of Railway Vehicles imply that authorization for operation of railway vehicles will only be granted where certain limit values as regards emissions are met. Again the applicable limit value depends on the date the respective railway vehicles are placed on the market for the first time.

Limit values as regards emissions of railway vehicles have been adopted by the European Union and are in particular set out in the following directives:

- Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery;

- Directive 2004/26/EC of the European Parliament and of the Council of 21 April 2004 amending Directive 97/68/EC on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery; and

- Commission Directive 2010/26/EU of 31 March 2010 amending Directive 97/68/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery.

The directives set out different limit values for locomotives and railcars as regards their emissions and apply to railway vehicles with rated power of more than 130 kW for propulsion engines.

All three directives have been inter alia implemented into German law by the adoption of the

28th Regulation to the Federal Immission Protection Law.

The tables below set out the respective limit values. The dates refer to the date on which the engines are placed on the market for the first time, i.e. at this time the respective engine must fulfill the respective limit values set out below:

Locomotives

Category: Net power (P) (kW)		Limit values			
		Carbon monoxide (CO) (g/kWh)	Hydrocarbons (HC) (g/kWh)	Oxides of nitrogen (NOx) (g/kWh)	Particulates (PT) (g/kWH)
as of 2007	130 kW ≤ P ≤ 560 kW	3.5	4.0		0.2
as of 2009	P > 560 kW	3.5	0.5	6.0	0.2
	P>2000 kW and SV> 5 l/cylinder	3.5	0.4	7.4	0.2
as of 2012	P >130 kW	3.5	4.0		0.025

Source: Directive 2004/26/EC

Railcars

Category: Net power (P) (kW)		Carbon monoxide (CO) (g/kWh)	Hydrocarbons (HC) (g/kWh)	Oxides of nitrogen (NOx) (g/kWh)	Particulates (PT) (g/kWH)
as of 2006	P >130 kW	3.5	4.0		0.2
as of 2012	P >130 kW	3.5	0.19	2.0	0.025

Source: Directive 2004/26/EC

3. Composition of fuel

The same rules apply as with regard to HDV.

4. Operation of railway vehicles

There are to the knowledge of the author no specific rules to that extent as regards emissions, i.e. air pollution. The major focus rests with regard to the operation of railway vehicles on the reduction of noise generated by railway vehicles.

In the absence of any specific rule, the general rule as set out in § 38 of the Federal Immission Protection Law applies, meaning that avoidable emissions should be prevented and that unavoidable emissions should be limited to a minimum.

Inland waterway vessels

Regarding the operation of vessels it needs to be distinguished between the operation of inland waterway vessels and seagoing vessel as there are different rules to that extent.

1. General

   In addition to the Federal Immission Protection Law referred to above, in particular the following laws and regulations are applicable to the operation of inland waterway vessels in Germany:

   - Inland Waterways Act (Binnenschifffahrtsgesetz);
   - Inland Waterways Responsibilities Act (Binnenschifffahrtsaufgabengesetz);
   - Federal Waterway Act (Bundeswasserstraßengesetz);
   - Regulations for the Inspection of Inland Vessels (Binnenschiffsuntersuchungs-Ordnung);
   - Rhine Vessel Inspection Regulation (Rheinshiffsuntersuchungsordnung).

   Based on those laws and regulation a number of further regulations and administrative guidelines have been issued.

2. Limits as regards (diesel) engines for inland waterway vessels

   Like railway vehicles and HDV, inland waterway vessels can in general only be operated on inland waters in Germany if they have an authorization of the German authorities to do so. In order to receive such an authorization defined emission limits for engines have to be adhered to.

   Admissible limits as regards emission of engines used in inland waterway vessels have been set out in directives of the Central Commission for Navigation on the Rhine ("Zentralkommission für die Rheinschifffahrt") and the European Union. Today the limit values set out by both organisations are equally applicable.

   - In 2004 the European Union adapted a directive setting out certain limits as regards the emission of engines used in inland waterway vessels. Those limits have been defined both by Directive 97/68/EC and Directive 2004/26/EC – the same directives that are applicable to railway vehicles.

The limits for inland waterway vessels apply in principle to all engines placed on the market at the dates set out in the table and are as follows:

Category: swept volume/net power (SV/P) (litres per cylinder/kW)		Limit values		
		Carbon monoxide (CO) (g/kWh)	Sum of hydrocarbons and oxides of nitrogen (HC+NOx) (g/kWh)	Particulates (PT) (g/kWH)
as of 2007	V1:1 SV<0.9 and P>37 kW	5.0	7.5	0.40
	V1:2 0.9 ≤SV<1.2	5.0	7.2	0.30
	V1:3 1.2≤SV<2.5	5.0	7.2	0.20
as of 2009	V1:4 2.5≤ SV<5	5.0	7.2	0.20
	V2:1 5≤ SV<15	5.0	7.8	0.27
	V2:2 15≤ SV< 20 and P<3300 kW	5.0	8.7	0.50
	V2:3 15≤ SV<20 and P>3300 kW	5.0	9.8	0.50
	V2:4 20≤SV<25	5.0	9.8	0.50
	V2:5 25≤SV<30	5.0	11.0	0.50

Source: Directive 2004/26/EC

Directive 2004/26/EC has been implemented inter alia into German law by

Regulation to Limit Exhaust Emissions of Diesel Engines in Inland Waterway Vessels (Binnenschiffs-Abgasemissionsverordnung).

- Already in 2000 the Central Commission for Navigation on the Rhine – an international organisation located in Strasbourg – set out certain limits inland waterway vessels have to meet in order to be allowed to operate on the Rhine. Those limits are set out in the Rhine Vessel Inspection Regulation and are in principle applicable to all diesel engines installed in inland waterway vessels operating on the Rhine since 2003:

P_N (kW)	Limit values (stage I)			
	CO (g/kWh)	HC (g/kWh)	NO_X (g/kWh)	PT (g/kWh)
$37 \leq P_N < 75$	6.5	1.3	9.2	0.85
$75 \leq P_N < 130$	5.0	1.3	9.2	0.70
$P_N > 130$	5.0	1.3	n (500-2800) = 45 x $n_n^{(-0.2)}$ n >2800 = 9.2	0.54

As of 1 July 2007 (date of putting in service of the inland waterway vessel) those limit values were tightened:

P_N (kW)	Limit values (stage II)			
	CO (g/kWh)	HC (g/kWh)	NO_X (g/kWh)	PT (g/kWh)
$19 \leq P_N < 37$	5.5	1.5	8.0	0.8
$37 \leq P_N < 75$	5.0	1.3	7.0	0.4
$75 \leq P_N < 130$	5.0	1.0	6.0	0.3
$130 \leq P_N < 560$	3.5	1.0	6.0	0.2
$P_N \geq 560$	3.5	1.0	$n \geq 3150$ min-1 = 6.0 $343 \leq n < 3150$ min-1 = 45 . n (-0,2) – 3 $n < 343$ min-1 = 11.0	0.2

The Rhine Vessel Inspection Regulation was implemented into German law by the Regulations for the Inspection of Inland Vessels.

3. Composition of fuel used for the operation of inland waterway vessels

Here in principle the same rules apply as with regard to HDV and railway vehicles. However, further distinctions are being made:

- It is only allowed to use other fuel than diesel fuel in inland waterway vessels where the amount of Sulphur in fuel does not exceed the limit values for diesel fuel;

- Marine diesel can only be used if the amount of Sulphur used in the marine diesel does not exceed 15 g/kg.

4. Operation of inland waterway vessels

To the knowledge of the author there do not exceed any specific rules regarding the operation of inland waterway vessels as regards emissions. Therefore, the same general rules apply as with regard to railway vehicles.

Seagoing vessels

According to the German Federal Environment Agency, 90 % of the goods are transported by sea worldwide.[4]

1. General

   The operation of seagoing vessels is in particular regulated by the following German laws and regulations:

   - Federal Maritime Responsibilities Act (Schiffsaufgabengesetz);
   - Ship Safety Act (Schiffssicherheitsgesetz);
   - Ship Safety Regulation (Schiffssicherheitsverordnung);
   - Marine Environmental Behaviour Regulation (Seeumweltverhaltensverordnung).

   Those laws and regulations implement to a certain extent regulations issued by the International Maritime Organisation (IMO) – an organisation of the United Nations founded to promote maritime safety. IMO ship pollution rules are contained in the "International Convention on the Prevention of Pollution from Ships", known as MARPOL 73/78. Regulations as regards emissions are contained in Annex VI to the convention.

2. Limits as regards (diesel) engines used in seagoing vessels

   Seagoing vessels operating under the German flag have to adhere to certain technical standards. Parts of those standards are the limit values as regards NO_x-emissions set out in Regulation 13 of MARPOL Annex VI.

   If those standards are met an Engine International Air Pollution Prevention Certificate will be issued certifying compliance with those standards. Such certificate has to be maintained on the seagoing vessel.

   The standards set out in Regulation 13 of MARPOL Annex VI are applicable to engines built on or after 1 January 2000. Those standards have been further tight-

[4] Cf. website of the Federal Environment Agency, available at: http://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsstandards/seeschiffe.

ened in 2008. For seagoing vessels operating in Emission Control Areas (in the following "ECA") the standards are since 2016 even stricter. Overall there are three limit values referred to as Tier I – III, however, Tier III only applies to ECA – in Germany this is the North Sea and the Baltic Sea:

PN (kW)	**Limit values**
	NO_x (g/kWh)
as of 1 January 2000 (Tier I)	
n<130	17.0
130≤n<2000	$45 \times n^{(-0.2)}$
n≥2000	9.8
as of 1 January 2011 (Tier II)	
n<130	14.4
130≤n<2000	$44 \times n^{(-0.23)}$
n≥2000	7.7
as of 1 January 2016 (Tier III)	
n<130	3.4
130≤n<2000	$9 \times n^{(-0.2)}$
n≥2000	2.0

Engines with a power output of more than 5.000 kW built before 2000 but after 1990 shall also comply with Tier I limit values.

3. Composition of fuel used for the operation of seagoing vessels

As regards the composition of fuel used for the operation of seagoing vessels measures have been taken on an international and a European level.

- On a global level, in 2008, Regulation 14 of MARPOL Annex VI was adopted which regulates the Sulphur content in fuel. Thereby, global standards and standards for Sulphur Emission Control Areas (in the following "SECA") – in Germany the Baltic Sea and the North Sea – have been adopted:

Standard	Sulphur limit values	Entry into force
Global standard	4.50 % (45.000 ppm)	applicable until 2012
	3.50 % (35.000 ppm)	beginning 2012
	0.50 % (5.000 ppm)	beginning 2020 (entry into force date to be reviewed in 2018, date may be postponed to 2025)
SECA	1.50 % (15.000 ppm)	applicable before 1 July 2010

Standard	Sulphur limit values	Entry into force
	1.00 % (10.000 ppm)	beginning 1 July 2010
	0.10 % (1.000 ppm)	beginning from 2015
	Alternatives (e.g. scrubber) are allowed	

- On a European level the content of Sulphur in fuel was in particular regulated by:

  - Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the Sulphur content of certain liquid fuels and amending Directive 93/12/EEC;

  - Directive 2005/33/EC of the European Parliament and the Council amending Directive 1999/32/EC as regards the sulphur content of marine fuels.

  By the amendment of Directive 2005/33/EC parallel requirements in the European Union to those in MARPOL Annex VI, Regulation 14, in respect of the Sulphur content of marine fuels were introduced. In addition, it also introduced inter alia a 0.1% maximum Sulphur requirement for fuels used by seagoing vessels at berth in ports of the European Union from 1st January 2010.

  In addition,

  > Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 amending Council Directive 1999/32/EC as regards the Sulphur content of marine fuels

  was adapted. The aim of the directive is to implement the global standards set out by the IMO in 2008 consistently within the European Union.

- The regulations of the IMO and the directives referred to above were implemented in Germany by the Marine Environmental Behavior Regulation.

4. Operation of seagoing vessels as regards emissions

   The operation of seagoing vessels as regards the environment respectively emissions is inter alia regulated in the Federal Maritime Responsibilities Act.

Aircrafts

Rules as regards the emissions of aircrafts have been defined mainly by the International Civil Aviation Organization (in the following "ICAO").

1. General

   The operation of aircrafts is in particular regulated by the following German laws and regulations:

   - Air Traffic Act ("Luftverkehrsgesetz");

   - Air Traffic Licencing Regulation ("Luftverkehrszulassungsordnung");

   - Air Traffic Regulation ("Luftverkehrsordnung");

   Those laws and regulations imply that to a certain extent regulations issued by the ICAO are applicable. ICAO aircraft pollution rules are contained in Annex 16 Volume II, chapter 2 (concerns subsonic speeds) of the "Convention on International Civil Aviation".

   In addition a number of regulations have been issued by the European Union declaring the standards set out by the ICAO to be applicable within the European Union.

2. Limit values as regards turbojet and turbofan engines at subsonic speeds

   German aircrafts are only allowed to operate if they are authorized for air traffic. In order to receive authorization for air traffic aircrafts have to be in accordance with the state of the art.

   An aircraft is only in compliance with the "state of the art" if the limit values for turbojet and turbofan engines as regards smoke and gaseous emissions are met. Thereby Annex 16, Volume II, chapter 2 sets out limit values for gaseous emissions concerning hydrocarbons, carbon monoxide and oxides of nitrogen.

   - In more detail:

     - The limit value for smoke has been applicable since January 1983. It is 83.6 $(F_{00})^{-0.274}$ or a value of 50, whichever is lower; F_{00} stands for rated thrust;

- The limit values for hydrocarbons and carbon monoxide have been applicable since 1 January 1986 and apply to all engines with a rated thrust of greater than 26.7 kN. They are as follows (D_p meaning the mass of any gaseous pollutant emitted during the reference emissions landing and take off cycle being measured in grams):

  Hydrocarbons (HC): 19.6 (D_p/F_{00});
  Carbon monoxide (CO): 118 (D_p/F_{00});

- The limit values for oxides of nitrogen (NO_x) are more differentiated and apply as of different dates. For engines of a type or model of which the date of manufacture of the first individual production model was after 1st January 2014 they are as follows[5]:

  for engines with a pressure ratio of 30 or less:

  i. for engines with a maximum rated thrust of more than 89.0 kN: $Dp/Foo = 7.88 + 1.4080\pi oo$

  ii. for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN: $Dp/Foo = 40.052 + 1.5681\pi oo - 0.3615Foo - 0.0018\ \pi oo \times Foo$

  for engines with a pressure ratio of more than 30 but less than 104.7:

  i. for engines with a maximum rated thrust of more than 89.0 kN: $Dp/Foo = -9.88 + 2.0\pi oo$

  ii. for engines with a maximum rated thrust of more than 26.7 kN but not more than 89.0 kN: $Dp/Foo = 41.9435 + 1.505\pi oo - 0.5823Foo + 0.005562\pi oo \times Foo$

  for engines with a pressure ratio of 104.7 or more: $Dp/Foo = 32 + 1.6\pi oo$

- The limit values of the ICAO have been to a certain extent directly declared to be applicable by regulations of the European Union:

[5] Source: https://easa.europa.eu/document-library/icao-aircraft-engine-emissions-databank#8.

- Commission Regulation (EU) No 748/2012 of 3 August 2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organizations;

- Commission Regulation (EU) No 7/2013 amending Commission Regulation (EU) No 748/2012 laying down Implementing Rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organizations;

- Commission Regulation (EU) No 69/2014 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organizations;

- Commission Regulation (EU) No 2016/5 of 5 January 2016 amending Regulation (EU) No 748/2012 as regards the implementation of essential requirements for environmental protection.

Those regulations are – according to European law – directly applicable within the member states of the European Union.

3. Operation of aircrafts as regards emissions

The operation of aircrafts as regards the environment respectively emissions is inter alia regulated by § 38 of the Federal Immission Protection Act.

III. Are international and/or European rules (if applicable) fully implemented in your country?

As set out above, the international and / or European rules referred to above as regards HDV, railway vehicles and inland waterway vessels have been fully implemented into German law.

As regards seagoing vessels it seems that not all aspects of the international rules have been fully implemented into German law, however, the author of this report was – due to time restraints – not able to assess whether in fact every aspect of the respective rules of the IMO has been fully implemented into German law. The same applies to aircrafts. Yet, at least the limit values set out above seem to be fully applicable – to the extent they already apply by the international rules themselves.

IV. Do national rules provide stricter or less strict requirements than international and/or European regulations (if applicable)?

HDV and railway vehicles

As regards HDV and railway vehicles, German rules do not seem to provide stricter or less strict requirements as regards international and / or European regulations.

Inland waterway vessels

As regards inland waterway vessels German rules also do not seem to provide stricter or less strict requirements as regards international and / or European regulations.

However, the limit values as regards emissions set out in international rules and European rules differ. Those are equally applicable.

Compared directly, the limit values of stage II of the Rhine Vessel Inspection Regulation and the limit values of Directive 2004/26/EG as regards NOx-emissions only slightly differ. Yet, the limit values as regards particle emissions of stage II of the Rhine Vessel Inspection Regulation are as regards smaller engines stricter, however, with regard to bigger engines, less strict than those of Directive 2004/26/EG.

Seagoing vessels

Whether German law provides for less strict rules than international rules depends on the answer to question III. As already pointed out there, the author believes that at least the limit values of the international rules have been fully implemented at an equal level.

German law provides insofar for stricter rules than international rules as on a European level a 0.1% maximum Sulphur requirement for fuels used by seagoing vessels at berth in ports of the European Union has been introduced. Such limit value has not been introduced by the international rules set out above.

Aircrafts

Whether German law provides for less strict rules than international rules depends on the answer to question III. As already pointed out there, the author believes that at least the limit values of the international rules have been fully implemented at an equal level. There do not seem to be stricter rules applicable.

V. What are possible consequences if the requirements set forth in the rules are not fulfilled?

With the exception of aircrafts, the fulfilment of the rules set out above is facilitated by a number of administrative offences. A violation of those offences may lead to a fine. However, the following list does not claim to be exhaustive and there may be other consequences as well.

HDV

There are a number of administrative offences applicable:

- As regards the fulfillment of the applicable limit values set out above, according to §§ 37 para 1, 27 para 1 Regulation for the Approval of Vehicles in connection with § 24 para 1 Road Transport Law it is an administrative offence to offer, sell or place on the market a HDV without having a valid certificate proving that the applicable limit values as regards emissions of the engine installed in a HDV are met ("Certificate of Conformity").

- A person that places fuel on the market that does not fulfill the requirements set out in the 10th Regulation to the Federal Immission Protection Law commits an administrative offence, cf. § 20 of the 10th Regulation to the Federal Immission Protection Law in connection with § 62 of the Federal Immission Protection Law.

- A violation of the rules of conduct set out above as regards the operation of HDV can lead to a fine:

  - A violation of § 30 Road Traffic Regulation is considered an administrative offence and can be fined by the German authorities, cf. § 49 Road Traffic Regulation in connection with § 24 Road Transport Law.

  - Where a driver of a HDV ignores a Low-Emission Zone and drives through this zone even though he is not entitled to do so since his HDV does not fulfill the relevant green gashouse emission limit values acts in violation of § 41 Road Traffic Regulation in connection with § 24 Road Transport Law and commits an administrative offence.

Railway vehicles

Here at least the following administrative offences exist:

- It is an administrative offence to place an engine on the market that does not fulfill the applicable limit values set out above, cf. § 11 of the 28th Regulation to the Federal Immission Protection Law in connection with § 62 of the Federal Immission Protection Law.

- A person that places fuel on the market that does not fulfill the requirements set out in the 10th Regulation to the Federal Immission Protection Law commits an administrative offence, cf. § 20 of the 10th Regulation to the Federal Immission Protection Law in connection with § 62 of the Federal Immission Protection Law.

- As regards the operation of railway vehicles, a violation of § 38 of the Federal Immission Protection Law constitutes an administrative offence, cf. § 62 para 1, no 7a Federal Immission Protection Law.

Inland waterway vessels

With regard to inland waterway vessels similar, partly the same, administrative offences exist as with regard to railway vehicles:

- As regards the limit values set out above, according to § 4 of the Regulation to Limit Exhaust Emissions of Diesel Engines in Inland Vessels it is an administrative offence to place an engine on the market that does not fulfill the limits set out in Directive 2004/26/EC.

- A person that places fuel on the market that does not fulfill the requirements set out in the 10th Regulation to the Federal Immission Protection Law commits an administrative offence, cf. § 20 of the 10th Regulation to the Federal Immission Protection Law in connection with § 62 of the Federal Immission Protection Law.

- As regards the operation of inland waterway vessels, a violation of § 38 of the Federal Immission Protection Law constitutes an administrative offence, cf. § 62 para 1, no 7a Federal Immission Protection Law.

Seagoing vessels

Here also some administrative offences exist:

- As regards the limit emission values set out above:

- A skipper commits according to § 14 of the Ship Safety Regulation in connection with § 15 of the Federal Maritime Responsibilities Act an administrative offence if he does not maintain an Engine International Air Pollution Prevention Certificate on the seagoing vessel.

- According to § 23 of the Marine Environmental Behavior Regulation in connection with § 15 of the Federal Maritime Responsibilities Act it is an administrative offence to operate a marine diesel engine that does not fulfil certain requirements of Regulation 13 of MARPOL Annex VI.

- According to § 23 of the Marine Environmental Behavior Regulation in connection with § 15 of the Federal Maritime Responsibilities Act it is an administrative offence to use marine fuel that does not fulfill inter alia requirements in Regulation 14 of MARPOL Annex VI.

Aircrafts

With regard to aircrafts, a violation of § 38 of the Federal Immission Protection Law should constitute an administrative offence, cf. § 62 para 1, no 7a Federal Immission Protection Law.

VI. If you compare the existing rules for the different means of transport, would you say that there are particularly strict rules for certain means of transport?

Considering the rules set out above under question I, it seems that there exist in particular strict rules with regard to HDV. This is because the limit values set out above are stricter and there exist limit values for more kinds of emissions than for the other means of transport.

As regards the emission of railway vehicles there exist less stringent emission levels than with regard to HDV.

The rules regarding the operation of inland waterway vessels concerning emissions are compared to HDV and to a certain extent also compared to railway vehicles less strict.

As regards emissions of seagoing vessels and in particular the applicable limit values the rules to that extent seem to be far less strict than the ones for HDV, railway vehiles and inland waterway vessels mentioned above.

The standards for aircrafts seem to be less strict than the ones for all other means of transport. It seems that in particular with regard to aircrafts a limit value as regards

CO_2 emissions would be specifically necessary. However, no such binding limit value exists so far.

PART B: LEGISLATION FOR MEANS OF TRANSPORT REGARDING ACCIDENTS / COLLISIONS INCLUDING HAZARDOUS GOODS

Introduction

There are a number of rules in place in Germany with regard to all means of transport that provide how HDV, railway vehicles, inland waterway vessels, seagoing vessels and airplanes have to be constructed – not only to avoid emissions. Those rules are spread over a number of laws, regulations and administrative guidelines. Moreover, there are also rules in place that provide how load has to be secured for carriage. All of those rules inter alia aim at preventing accidents / collisions and are to a large extent based on rules of the European as well as on international rules. As regards rules that apply when accidents / collisions have happened there seems to be a particular focus on accidents / collisions at sea which are largely influenced by rules of the IMO.

Furthermore, the law concerning contracts may not necessarily aim at preventing accidents / collisions, however, such law also sets out rules that may help to avoid accidents / collisions as it provides for rules how all means of transport have to be loaded and also what information needs to be submitted in order to ensure a secure transportation and therefore also helps to avoid a possible negative impact on the environment.

Furthermore, with regard to all means of transport there apply special rules with regard to the transportation of hazardous goods. Those rules are to a large extent based on international rules.

In the following only a broad outline is being provided as regards the rules applying to accidents / collisions with regard to all means of transport which does not claim to be comprehensive. Only public law is considered. Furthermore, it only partly considers whether the non-compliance with the applicable laws may lead to an administrative offence and / or criminal offence.

HDV

1. General rules

There are a number of rules in place regulating how vehicles in general and therefore also HDV have to be constructed in order to avoid accidents and to minimise harm in particular on individuals if they happen. Only HDV fulfilling the technical requirements set out in the applicable legislation are authorised to operate on roads in Germany.

Those rules are inter alia set out in Regulation Authorising the Use of Vehicles for Road Traffic which is – as mentioned above – to some extent based on legislation of the European Union but also on international rules.

As regards carriage of goods and accidents that may result from the carriage of those goods the following provisions seem to be worthwhile mentioning:

- § 32 of the Regulation Authorising the Use of Vehicles for Road Traffic provides that inter alia HDV in principle have to adhere to certain dimensions if operated on roads in Germany.

- § 34 of the Regulation Authorising the Use of Vehicles for Road Traffic provides that inter alia HDV in principle have to adhere to certain limits as regards their overall weight if operated on roads in Germany.

- § 22 Road Traffic Regulation regulates how load has to be secured on inter alia HDV.

The adherence of those rules is – on a daily basis – observed by the police and – on a more general basis – by the MOT ("TÜV") that checks every year whether a HDV is in compliance with the applicable laws and regulations.

Violations inter alia of the rules set out above are considered to be an administrative offence and may lead to a fine.

2. Hazardous goods

As regards the handling of hazardous goods in case accidents / collisions occur, on a national level in particular the following law and regulation are of importance:

- Hazardous Goods Transportation Act (Gefahrgutbeförderungsgesetz);

- Regulation on the Transport of [...]Dangerous Goods by Road, Rail and Inland Waterway Vessels (Gefahrgutverordnung);

- Regulation for Commissioners for Hazardous Goods ("Gefahrgutbeauftragtenverordnung").

In addition there are a number of provisions in place regarding the protection of employees handling hazardous goods.

In particular the German Regulation on the Transport of [...]Dangerous Goods by Road, Rail and Inland Waterway Vessels is of importance as it regulates how hazardous goods have to be handled. It regulates in its § 4 general obligations as regards safety:

- People involved in the transportation of hazardous goods have to provide for predictable measures in order to avoid event of damages and in case such an event happens to minimise its consequences;

- In case an accident happens and there is a risk that hazardous goods leak out or may leak out and those may not be removed quickly the competent authorities have to be informed.

Moreover, the Regulation on the Transport of Dangerous Goods by Road, Rail and Inland Waterway Vessels sets out a number of more specific rules as to how hazardous goods have to be handled and also how they have to be prepared for transportation. This includes rules regarding information on hazardous goods as such and information as to how hazardous goods have to be packed, labelled and loaded.

The regulation implements a directive of the European Union - Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods. It further regulates that a great deal of provisions of the European Agreement concerning the International Carriage of Dangerous Goods by Road ("ADR") have to be observed.

The Regulation on the Transport of [...]Dangerous Goods by Road, Rail and Inland Waterway Vessels provides in its § 37 for a number of administrative offences in case the requirements set out in the regulation are not observed.

Furthermore, it is a criminal offence to inter alia transport, pack, load and unload hazardous goods and thereby violating administrative obligations if that leads to danger of the health of another person, animals, plants, air, ground or waters.

In addition, in order to ensure that the rules set out in the Regulation on the Transport of [...]Dangerous Goods by Road, Rail and Inland Waterway Vessels are observed in companies participating in the carriage of hazardous goods, such companies have to employ a hazardous material commissioner, cf. Regulation for Commissioners for Hazardous Goods. Such commissioner is also inter alia obliged to provide an accident report.

Railway vehicles

As regards railway vehicles the same principles apply as with regard to HDV.

1. General

There are a number of rules in place regulating how railway vehicles have to be constructed in order to avoid accidents and to minimise harm in particular on individuals if they happen. Again, a railway vehicle is only allowed to operate in Germany if it has authorisation to do so.

A railway vehicle in particular has to fulfil the technical requirements set out in:

Railway Construction and Operations Regulation.

Like with regard to HDV it also provides for requirements as regards the dimensions and overall weights of railway vehicles, cf. § 18.

The technical specifications a railway vehicle needs to fulfill are based on directives and regulations that have been issued by the European Union.

2. Hazardous Goods

To the handling of hazardous goods as regards rail transportation in principle the same rules apply as with regard to HDV.

With the Regulation on the Transport of [...]Dangerous Goods by Road, Rail and Inland Waterway Vessels also the Regulation concerning the International Carriage of Dangerous Goods by Rail ("RID") is declared to be applicable.

Inland waterway vessels

As regards inland waterway vessels the same principles apply as with regard to HDV.

1. General

   There are also a number of rules in place regulating how inland waterway vessels have to be constructed in order to avoid accidents and to minimise harm in particular on individuals if they happen. Of particular importance are the:

   - Inland Waterways Act;
   - Inland Waterways Responsibilities Act;
   - Regulations for the Inspection of Inland Vessels;
   - Rhine Vessel Inspection Regulation.

   This legislation inter alia regulates the technical requirements of inland waterway vessels.

2. Hazardous Goods

   To the handling of hazardous goods as regards rail transportation in principle the same rules apply as with regard to HDV.

   With the Regulation on the Transport of Dangerous Goods by Road, Rail and Inland Waterway Vessels also the European Agreement concerning the International Carriage of Dangerous [...]Goods by Inland Waterway Vessels ("ADN") is declared to be applicable.

Seagoing vessels

Concerning seagoing vessels, the same principles apply as set out above, i.e. a seagoing vessels have to fulfill certain technical requirements in order to receive authorization for operation under the German flag. In addition, a number of legislation has been adopted regulating accidents / collisions at sea – both in general as well as with regard to hazardous goods.

1. General

   A bit less specific, but in line with the principles set out above, seagoing vessels have to adhere to specific weight limits. However, unlike HDV and railway vehicles on an

international level it has been regulated that goods intended to be transported by sea have to be weighed pretty precisely. To that extent the International Convention for the Safety of Life at Sea ("SOLAS") has been amended by the „Guidelines regarding the Verified Gross Mass of a Container Carrying Cargo" (generally referred to as "MSC.1/Circ.1475"). According to those rules the weighing of containers will have to be more precise as it has been to date. The respective rules apply as of 1 July 2016; however, they have not been implemented into German law yet.
Furthermore, there are a number of rules in place specifically regulating accidents / collisions at sea. In Germany, inter alia the following rules have been implemented:

- Convention on International Regulations for Preventing Collisions at Sea;

- Directive 2009/18/EC establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and amending Council Directive 1999/35/EC and Directive 2002/59/EC of the European Parliament and of the Council.

2. Hazardous goods

As regards hazardous goods, the Regulation on the Transport of [...]Dangerous Goods by Sea ("Gefahrgutverordnung See") regulates how hazardous goods are to be handled. The regulation implements:

- Directive 2002/59/EC establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC;

- Applicable rules to hazardous goods as regards MARPOL and SOLAS.

Aircrafts

Like with regard to the other means of transport, German aircrafts may only be operated if they fulfill certain technical requirements. This also aims at preventing accidents / collisions. As regards the transportation of hazardous goods by aircrafts the ICAO has issued provisions which are also applicable in Germany.

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