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Ordinance on Air Pollution Control (OAPC)

of 16 December 1985 (Status as of 1 April 2017)

The Swiss Federal Council,

on the basis of Articles 12, 13, 16 and 39 of the Federal Act of 7 October 1983¹ on the Protection of the Environment (the Act),

ordains:

Chapter 1 General Provisions

Art. 1 Aim and scope

¹ This Ordinance is intended to protect human beings, animals and plants, their biological communities and habitats, and the soil against harmful effects or nuisances caused by air pollution.

² It regulates:

- a. the preventive limiting of emissions from installations, as defined in Article 7 of the Act, which pollute the air;
- a^{bis,2} open-air waste incineration;
- b. requirements for thermal and motor fuels;
- c. maximum permitted ambient air pollution levels (ambient limit values);
- d. the procedure in the event of excessive ambient air pollution levels.

Art. 2 Definitions

¹ *Stationary installations* means:

- a. buildings and other fixed structures;
- b. terrain modifications;
- c. equipment and machines;

AS 1986 208

¹ SR 814.01

² Inserted by No I of the Ordinance of 20 Nov. 1991, in force since 1 Feb. 1992 (AS 1992 124).

- d. ventilation systems which collect vehicle exhaust gases and discharge them as waste air into the environment.

² *Vehicles* means motor vehicles, aircraft, ships and railways.

³ *Transport infrastructure* means roads, airfields, railway tracks and other installations where vehicle exhaust gases are released into the environment as waste air without being collected.

⁴ *New installations* also includes installations which are altered, extended or repaired if:

- a. higher or different emissions are to be expected as a result; or
- b. the costs incurred amount to more than half those of a new installation.

⁵ Ambient air pollution levels are *excessive* if one or more of the ambient limit values specified in Annex 7 is exceeded. If no such limit values are specified for a pollutant, ambient air pollution levels shall be considered excessive if:

- a. they endanger human beings, animals, plants or their biological communities or habitats;
- b. a survey establishes that they significantly affect the well-being of a substantial proportion of the population;
- c. they damage buildings; or
- d. they harm soil fertility, vegetation or waters.

⁶ *Placing on the market* means the transfer or disposal for the first time, whether or not for consideration, of equipment or machines for distribution or use in Switzerland. Equivalent to placing on the market is the commissioning, for the first time, of equipment or machines at one's own enterprise in cases where placing on the market has not previously occurred.³

Chapter 2 Emissions

Section 1 Limitation of Emissions from New Stationary Installations

Art. 3 Preventive limiting of emissions in accordance with Annexes 1–4

¹ New stationary installations shall be equipped and operated in such a way that they comply with the emission limits specified in Annex 1.

² Additional or different requirements apply in the case of the following installations:

- a. installations listed in Annex 2: the requirements specified therein;
- b. combustion installations: the requirements specified in Annex 3;

³ Amended by No I of the Ordinance of 18 June 2010, in force since 15 July 2010 (AS 2010 2965).

- c.⁴ construction machines and particle filter systems as specified in Article 19a, combustion installations as specified in Article 20 and machinery as specified in Article 20b: the requirements specified in Annex 4.

Art. 4 Preventive emission limits specified by the authorities

¹ Emissions for which no limit is specified in this Ordinance or for which a particular limit is declared not to apply, shall be limited preventively by the authorities as far as is technically and operationally feasible and economically acceptable.

² Emission limitation measures are technically and operationally feasible if they:

- a. have been successfully tested at comparable installations in Switzerland or abroad or
- b. have been successfully applied in experiments and can be transferred to other installations from a technological perspective.

³ The assessment of the economic acceptability of emission limitations shall be based on an average, economically sound enterprise in the relevant sector. If a particular sector contains widely differing classes of enterprises, the assessment shall be based on an average enterprise of the relevant class.

Art. 5 Stricter emission limits ordered by the authorities

¹ If an individual planned installation is expected to cause excessive ambient air pollution levels even though the preventive emission limitation requirements are met, the authorities shall order additional or stricter emission limitation requirements for the installation concerned.

² The emission limitation requirements are to be supplemented or tightened to such an extent that no excessive ambient air pollution levels are caused.

Art. 6 Capture and removal of emissions⁵

¹ Emissions shall be captured as fully and as close to the source as possible and shall be removed in such a way as to prevent excessive ambient air pollution levels.⁶

² They shall generally be discharged above roof level via stacks or waste air ducts.

³ Annex 6 applies to stacks. If the required stack height H cannot be realised, or if the parameter H₀ is more than 100 m, the authorities shall as an alternative tighten the emission limitation requirements specified in Annexes 1–3.

⁴ Amended by No I of the Ordinance of 18 June 2010, in force since 15 July 2016 (AS 2010 2965).

⁵ Amended by No I of the Ordinance of 20 Nov. 1991, in force since 1 Feb. 1992 (AS 1992 124).

⁶ Amended by No I of the Ordinance of 20 Nov. 1991, in force since 1 Feb. 1992 (AS 1992 124).

Section 2 Limitation of Emissions from Existing Stationary Installations

Art. 7 Preventive limiting of emissions

The provisions concerning the preventive limiting of emissions from new stationary installations (Articles 3, 4 and 6) also apply to existing stationary installations.

Art. 8 Mandatory retrofitting

¹ The authorities shall ensure that existing stationary installations which do not meet the requirements of this Ordinance undergo retrofitting.

² They shall issue the necessary rulings, specifying the time limit for retrofitting in accordance with Article 10. If necessary, they shall order operating restrictions or the shutdown of the installation for the duration of the retrofitting work.⁷

³ Retrofitting need not be carried out if the owner undertakes to shut down the installation within the time limit set for retrofitting.

Art. 9 Stricter emission limits

¹ If it is established that an individual existing installation is causing excessive ambient air pollution levels even if the preventive emission limitation requirements are complied with, the authorities shall order additional or stricter emission limitation requirements for the installation concerned.

² The emission limitation requirements are to be supplemented or tightened to such an extent that excessive ambient air pollution levels are no longer caused.

³ The additional or stricter emission limitation requirements are to be imposed by means of retrofitting rulings with time limits set in accordance with Article 10, paragraph 2. If necessary, the authorities shall order operating restrictions or the shutdown of the installation for the duration of the retrofitting work.

⁴ If excessive ambient air pollution levels are caused by more than one installation, the procedure specified in Articles 31–34 shall be followed.

Art. 10⁸ Time limits for retrofitting

¹ The standard time limit for retrofitting is five years.

² Shorter time limits, but not less than 30 days, shall be set if:

- a. retrofitting can be carried out without significant investments;
- b. emissions are more than three times the value specified for the preventive limiting of emissions; or

⁷ Second sentence inserted by No I of the Ordinance of 20 Nov. 1991, in force since 1 Feb. 1992 (AS 1992 124).

⁸ However, see the Final Provisions of the Amendments of 20 Nov. 1991, 15 Dec. 1997 and 23 June 2004 at the end of this text.

- c. ambient air pollution levels caused by the installation alone are excessive.
- ³ Longer time limits, up to a maximum of ten years, shall be set if:
- a. emissions are less than one-and-a-half times the value applicable for the preventive limiting of emissions, or the provisions concerning exhaust gas losses are not complied with and
 - b. neither letter a nor letter c of paragraph 2 is met.
- ⁴ The above is without prejudice to the ordering of shorter time limits for retrofitting in accordance with Article 32.

Art. 11 Relief

¹ On request, the authorities shall grant relief to the owner of an installation if retrofitting in accordance with Articles 8 and 10 would be disproportionate, in particular not technically or operationally feasible, or economically unacceptable.

² By way of relief, the authorities may in the first instance grant longer time limits. If the granting of longer time limits is not sufficient, the authorities shall specify less strict emission limits.

Section 3 Control of Stationary Installations

Art. 12 Emission declaration

¹ Any person who operates or wishes to construct an installation which causes air pollution shall provide the authorities with information on:

- a. the type and level of emissions;
- b. the release location, release height and time course of emissions;
- c. other release conditions required for the assessment of emissions.

² The emission declaration may be based on measurements or on material balances of the substances used.

Art. 13 Emission measurements and inspections

¹ The authorities shall monitor compliance with emission limitation requirements. They shall carry out their own emission measurements or inspections or shall have these carried out on their behalf.

² If possible, the first measurement or inspection shall be carried out within three months, but no later than twelve months, after the commissioning of the new or retrofitted installation.

³ The measurement or inspections are generally to be repeated every two years in the case of combustion installations and every three years in the case of other installa-

tions.⁹ This is without prejudice to provisions to the contrary specified in Annexes 2, 3 and 4.¹⁰

⁴ In the case of installations which may produce significant levels of emissions, the authorities shall order continuous measurement and recording of emissions, or of another operating parameter which permits emission control.

Art. 14 Measurement procedures

¹ The measurements must cover the operating conditions which are relevant for assessment purposes. If necessary, the authorities shall specify the type and extent of measurements required and the operating conditions to be covered.

² Emission measurements shall be carried out according to the recognised rules of metrology. The Federal Office for the Environment (FOEN)¹¹ shall recommend suitable measurement methods.¹² The technical requirements for measurement systems and measurement stability are those specified in the Ordinance of 15 February 2006¹³ on Measuring Instruments.¹⁴

³ The owner of the installation to be inspected shall set up and make accessible suitable measuring stations in accordance with instructions issued by the authorities.

⁴ The measured and calculated values, the measurement methods used and the operating conditions at the installation at the time the measurements were performed shall be recorded in a measurement report.

Art. 15 Assessment of emissions

¹ The measured values shall be corrected to the reference values specified in Annex 1 Number 23.

² Unless otherwise specified in Annexes 1–4, the values calculated in accordance with paragraph 1 are to be expressed as hourly mean values for the assessment. In justified cases, the authorities may specify other suitable averaging periods.

³ In the case of approval and control measurements, emission control requirements shall be regarded as having been complied with if none of the mean values determined in accordance with paragraph 2 exceeds the limit value.

⁴ In the case of continuous measurements, emission limit values shall be regarded as having been complied with if, within a calendar year:

⁹ Amended by No I of the Ordinance of 15 Dec. 1997, in force since 1 March 1998 (AS **1998** 223).

¹⁰ Second sentence Amended by No I of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS **2015** 4171).

¹¹ Term in accordance with No I of the Ordinance of 18 June 2010, in force since 15 July 2010 (AS **2010** 2965). This amendment was taken into account throughout in the entire text.

¹² Second sentence Amended by No I of the Ordinance of 20 Nov. 1991, in force since 1 Feb. 1992 (AS **1992** 124).

¹³ **SR 941.210**

¹⁴ Third sentence inserted by No I of the Ordinance of 18 June 2010, in force since 15 July 2010 (AS **2010** 2965).

- a. none of the daily mean values exceeds the emission limit value;
- b. 97 % of all the hourly mean values are no more than 1.2 times the limit value;
- c. none of the hourly mean values is more than twice the limit value.

⁵ The authorities shall take account of the particular circumstances when assessing emissions during start-up and shut-down periods.

Art. 16 Bypass lines and malfunctions

¹ A bypass line may only be used to protect exhaust gas cleaning systems with the approval of the authorities.

² If significant emissions could occur as a result of the use of bypass lines or during malfunctions, the authorities shall specify what measures are to be taken.

Section 4 Emissions from Vehicles and Transport Infrastructure

Art. 17 Preventive limiting of emissions from vehicles

In accordance with legislation on road transport, aviation, shipping and railways, preventive measures shall be taken to control emissions from vehicles as far as is technically and operationally feasible and economically acceptable.

Art. 18 Preventive limiting of emissions from transport infrastructure

In the case of transport infrastructure, the authorities shall order such measures as are technically and operationally feasible and economically acceptable in order to control traffic-related emissions.

Art. 19 Measures to control excessive ambient air pollution levels from traffic

If vehicles or transport infrastructure have been shown or are expected to cause excessive ambient air pollution levels, the procedure specified in Articles 31–34 shall be followed.

Section 4a¹⁵ Requirements for Construction Machines and Particle Filter Systems

Art. 19a Requirements

¹ Machines and equipment for use on construction sites with internal combustion compression-ignition engines having a power output of more than 18 kW (construction machines) shall comply with the requirements specified in Annex 4 Number 3.

² New construction machines are only to be placed on the market if their conformity with the requirements specified in Annex 4 Number 3 has been demonstrated.

³ Construction machines are only to be operated with a particle filter system whose conformity with the requirements specified in Annex 4 Numbers 32 and 33 has been demonstrated.

⁴ The authority may on request grant exemptions from the requirements set out in Annex 4 Number 3 for construction equipment used for test or demonstration purposes. The exemptions are granted for a maximum of 10 days.¹⁶

Art. 19b Proof of conformity

¹ Proof of conformity comprises:

- a. a certificate issued by a conformity assessment body as specified in Article 18 of the Federal Act of 6 October 1995¹⁷ on Technical Barriers to Trade (TBA) to the effect that the type of construction machine or particle filter system meets the requirements of Annex 4 Number 3 (certificate of conformity);
- b. a declaration by the manufacturer or importer that the construction machines or particle filter systems to be placed on the market conform to the tested types (declaration of conformity), including the following details:
 1. name and address of the manufacturer or importer,
 2. designation of the type of construction machine, engine and particle reduction system,
 3. year of manufacture and serial numbers of the construction machine, engine and particle filter system,
 4. name and address of the conformity assessment body and number of the certificate of conformity,
 5. name and function of the person signing the declaration of conformity for the manufacturer or importer,
 6. the precise location of the markings on the construction machine; and
- c. markings as specified in Annex 4 Number 33.

¹⁵ Inserted by No I of the Ordinance of 19 Sept. 2008, in force since 1 Jan. 2009 (AS 2008 4639).

¹⁶ Inserted by No I of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS 2015 4171).

¹⁷ SR 946.51

² The conformity assessment bodies shall send certificates of conformity, together with the relevant test reports, to the FOEN. The FOEN shall publish lists of compliant particle filter system and engine types.¹⁸

³ The manufacturer or importer shall retain the declaration of conformity for ten years after placing the construction machine or particle filter system on the market.

Section 5¹⁹ Placing on the Market of Combustion Installations

Art. 20²⁰ Conditions for placing on the market

¹ The following combustion installations are only to be placed on the market if their conformity with the requirements specified in Annex 4 has been demonstrated (Art. 20a):

- a. forced draught burners for «extra light» fuel oil or gas with a rated thermal input of up to 350 kW;
- b. boilers for forced draught burners as specified in letter a, provided that the heat carrier is water and the shut-off temperature of the safety temperature limiter does not exceed 110 °C;
- c. boilers as specified in letter b intended to be equipped with forced draught burners (units);
- d. boilers and circulation heaters with atmospheric gas burners with a rated thermal input of up to 350 kW, provided that the heat carrier is water and the shut-off temperature of the safety temperature limiter does not exceed 110°C;
- e. boilers and circulation heaters as specified in letter d fitted with vaporising-type «extra light» fuel oil burners;
- f. direct gas-fired storage water heaters (boilers) containing more than 30 litres of water and with a rated thermal input of up to 350 kW;
- g. gas-fired instantaneous water heaters with a rated thermal input of 35 kW to 350 kW;
- h.²¹ combustion installations for fuels as specified in Annex 5 Numbers 2 and 3 with a rated thermal input of up to 350 kW, i.e. boilers, space heaters, cookers, storage heaters, inset appliances and open fires; exempted from the requirement for proof of conformity are combustion installations produced by craftsmen:

¹⁸ Amended by No I of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS 2015 4171).

¹⁹ Amended by No I of the Ordinance of 23 June 2004, in force since 1 Jan. 2005 (AS 2004 3561).

²⁰ See also the Final Provisions of the Amendments of 23 June 2004 below.

²¹ Inserted by No I of the Ordinance of 4 July 2007, in force since 1 Sept. 2007 (AS 2007 3875). See also the Final Provisions of the Amendments of 4 July 2007 below.

1. which were constructed using a recognised calculation method, in particular the tiled oven calculation programme of the Swiss Association of Stove Fitters and Tilers (VHP)²², or
2. in which the concentration of solids in flue gas under normal operating conditions is reduced by at least 60 % by means of a dust removal system.

2 ...²³

³ The cantons may allow practical testing of a limited number of installations without a declaration of conformity for a period of no more than two years. Installations which at the end of this period still lack a declaration of conformity in their existing form must be taken out of service.

Art. 20a Proof of conformity

¹ Proof of conformity for a combustion installation comprises:

- a.²⁴ a test report from a body under Article 18 TBA²⁵ confirming that the type in question meets the requirements of Annex 4;
- b. a declaration by the manufacturer or importer that the combustion installation to be placed on the market conforms to the tested type (declaration of conformity), including the following details:
 1. name and address of the manufacturer or importer,
 2. description of the combustion installation,
 3. provisions applicable in accordance with Annex 4,
 4. name and address of the conformity assessment body and number of the certificate of conformity,
 5. name and function of the person signing the declaration of conformity for the manufacturer or importer;
- c.²⁶ markings as specified in Annex 4 Number 23.

^{1bis} For equipment in terms of Annex 2.1 or 2.25 of the Energy Ordinance of 7 December 1998²⁷, proof of conformity may also be provided in accordance numbers 4 of these Annexes.²⁸

² The manufacturer or importer shall retain the declaration of conformity for ten years after placing the installation on the market.

²² Available from: Verband Schweizerischer Hafner- and Plattengeschäfte VHP, Solothurnerstrasse 236, 4603 Olten.

²³ Repealed by No I of the Ordinance of 18 June 2010, with effect from 15 July 2010 (AS 2010 2965).

²⁴ Amended by No III 1 of the Ordinance of 22 June 2016, in force since 1 Aug. 2016 (AS 2016 2479).

²⁵ SR 946.51

²⁶ Inserted by No I of the Ordinance of 22 Oct. 2008, in force since 1 Jan. 2009 (AS 2008 5163).

²⁷ SR 730.01

²⁸ Inserted by No III 1 of the Ordinance of 22 June 2016, in force since 1 Aug. 2016 (AS 2016 2479).

Section 5a²⁹ Placing Machinery on the Market

Art. 20b Conditions for placing on the market

Machines and equipment with a spark ignition engine having a power output of up to 19 kW (machinery) may only be placed on the market if the conformity of the engines with the requirements specified in Annex 4 Number 4 has been demonstrated.

Art. 20c Proof of conformity

¹ Proof of conformity comprises:

- a.³⁰ type-approval granted by an EU Member State for an engine type or engine family or the document specified in Annex VII to Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997³¹ 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
- b. engine markings as specified in Annex I Number 3 of Directive 97/68/EC.

² Conformity may also be proven by means of a certificate issued by a conformity assessment body as specified in Article 18 TBA³² to the effect that the type of machinery meets the requirements of Annex 4 Number 4 (certificate of conformity). In this case, the engine must bear the trade mark or trade name of the manufacturer of the engine and the name of the conformity assessment body.

Section 6 Thermal Fuels

Art. 21 Requirements

Thermal fuels are subject to the requirements specified in Annex 5.

Art. 22 Declaration

Any person who imports thermal fuels or offers them for sale on a commercial basis must declare the quality of the thermal fuel to the customer or consumer. On import, he must also declare the quality to the customs authorities.

²⁹ Inserted by No I of the Ordinance of 18 June 2010, in force since 15 July 2010 (AS 2010 2965).

³⁰ Amended by No I of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS 2015 4171).

³¹ OJ L59 of 27.02.1998, p. 1, last amended by Directive 2010/46/EU, OJ L 353 of 06.12.2012, p. 80.

³² SR 946.51

Art. 23³³**Section 7 Motor Fuels****Art. 24** Requirements

Motor fuels are subject to the requirements specified in Annex 5.

Art. 25 Declaration

Any person who imports motor fuels or offers them for sale on a commercial basis must declare the quality of the motor fuel to the customer or consumer. On import, he must also declare the quality to the customs authorities.

Art. 26 Installations for unleaded petrol

¹ Installations for unleaded petrol such as storage and transport tanks, tankers and petrol pumps must be clearly marked «unleaded».

² If an installation which previously contained leaded petrol is to be used for unleaded petrol, the owner of the installation must clean it thoroughly beforehand or take other measures to ensure that it does not contain excessive lead residues.

Section 8³⁴ **Waste Incineration****Art. 26a**³⁵ Incineration in installations

Waste may only be incinerated or thermally decomposed in installations specified in Annex 2 Number 7; an exception to this is the incineration of waste specified in Annex 2 Number 11.

Art. 26b³⁶ Incineration outside of installations

¹ Natural forest, field and garden waste may be incinerated outside installations if it is sufficiently dry to ensure minimal smoke formation.

² The authorities may in individual cases approve the incineration of forest, field and garden waste which is not sufficiently dry if there is an overriding interest and it does not lead to excessive ambient air pollution levels.

³³ Repealed by No I of the Ordinance of 4 July 2007, with effect from 1 Sept. 2007 (AS 2007 3875).

³⁴ Inserted by No I of the Ordinance of 20 Nov. 1991, in force since 1 Feb. 1992 (AS 1992 124).

³⁵ Amended by No I of the Ordinance of 4 July 2007, in force since 1 Sept. 2007 (AS 2007 3875).

³⁶ Inserted by No I of the Ordinance of 4 July 2007, in force since 1 Sept. 2007 (AS 2007 3875).

³ They may restrict or prohibit the incineration of forest, field and garden waste outside of installations for particular areas or periods if excessive ambient air pollution levels are to be expected.

Chapter 3 Ambient Air Pollution Levels

Section 1 Determination and Assessment

Art. 27 Determination of ambient air pollution levels

¹ The cantons shall monitor the air pollution situation and trends in their territory; in particular, they shall determine ambient air pollution levels.

² To this end, they shall carry out surveys, measurements and dispersion modelling. The FOEN shall recommend suitable methods.

Art. 28 Ambient air pollution forecast

¹ Before a stationary installation or transport infrastructure expected to be a significant source of emissions is constructed or retrofitted, the authorities may request the owner to provide an ambient air pollution forecast.

² The forecast must indicate what type, extent and frequency of ambient air pollution levels are to be expected in what areas.

³ The forecast shall include details of the type and level of emissions, as well as the dispersion conditions and the calculation methods used.

Art. 29 Monitoring in relation to individual installations

The owner of an installation which is a significant source of emissions may be requested by the authorities to monitor ambient air pollution levels by carrying out measurements in the area concerned.

Art. 30 Assessment of ambient air pollution levels

The authorities shall assess whether the ambient air pollution levels measured are excessive (Article 2 paragraph 5).

Section 2 Measures to Control Excessive Ambient Air Pollution Levels

Art. 31³⁷ Preparation of an action plan

The authorities shall draw up an action plan in accordance with Article 44a of the Act if it has been established or is to be expected that, in spite of the preventive limiting of emissions, excessive ambient air pollution levels are caused by:

- a. an item of transport infrastructure;
- b. a number of stationary installations.

Art. 32³⁸ Content of the action plan

¹ The action plan shall indicate:

- a. the sources of emissions which are responsible for causing excessive ambient air pollution levels;
- b. the significance of individual sources of emissions for the total pollution load;
- c. measures for reducing and eliminating excessive ambient air pollution levels;
- d. the effects of the various measures;
- e. the legal framework existing or yet to be established for the various measures;
- f. time limits for the ordering and implementation of the measures;
- g. the authorities responsible for enforcement of the measures.

² Measures under paragraph 1 letter c are:

- a. for stationary installations: shorter time limits for retrofitting or additional or stricter emission limits;
- b. for transport infrastructure: structural, operational, traffic management or traffic restriction measures.

Art. 33³⁹ Putting the action plan into effect

¹ The measures contained in the action plan are generally to be put into effect within five years.

² As a matter of priority, the authorities shall order measures for installations which account for more than 10 % of the total pollution load.

³⁷ Amended by No I of the Ordinance of 15 Dec. 1997, in force since 1 March 1998 (AS 1998 223).

³⁸ Amended by No I of the Ordinance of 15 Dec. 1997, in force since 1 March 1998 (AS 1998 223).

³⁹ Amended by No I of the Ordinance of 15 Dec. 1997, in force since 1 March 1998 (AS 1998 223).

³ The cantons shall regularly review the effectiveness of the measures and shall amend the action plans if necessary. They shall inform the public accordingly.

Art. 34 Applications from the cantons

¹ If a cantonal action plan provides for measures which fall within the responsibility of the Confederation, the canton shall submit the plan to the Federal Council and make the relevant applications.

² If the action plan requires the cooperation of another canton, the authorities shall submit the plan to the canton in question and make the relevant applications. If necessary, the Federal Council shall coordinate the action plans of the cantons.

Chapter 4 Final Provisions

Section 1 Enforcement

Art. 35 Enforcement by the cantons

Subject to the provisions of Article 36, the cantons shall be responsible for enforcement of this Ordinance.

Art. 36 Enforcement by the Confederation

¹ The Confederation shall enforce the provisions concerning:

- a. market surveillance for construction machines and particle filter systems, combustion installations and machinery (Article 37);
- b.⁴⁰ control of thermal and motor fuels on import and on placing on the market (Article 38).⁴¹

² When applying other federal acts or international agreements or resolutions relating to matters regulated by this Ordinance, federal authorities shall also enforce this Ordinance. Cooperation of the FOEN and the cantons is governed by Article 41 paragraphs 2 and 4 of the Act; these provisions are subject to legal requirements concerning secrecy.⁴²

³ The Federal Department of the Environment, Transport, Energy and Communications⁴³ may order implementing and supplementary provisions, particularly concerning:

- a. methods of testing, measurement and calculation;

⁴⁰ Amended by No I of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS 2015 4171).

⁴¹ Amended by No I of the Ordinance of 18. June 2010, in force since 15 July 2010 (AS 2010 2965).

⁴² Amended by No II 13 of the Ordinance of 2 Feb. 2000 to the Federal Act on the Coordination and Simplification of Decision-Making Procedures, in force since 1 March 2000 (AS 2000 703).

⁴³ The designation of the administration unit was amended by Art. 16 para. 3 of the Publications Ordinance of 17 Nov. 2004 (AS 2004 4937).

- b. type-approval;
- c. stacks.

⁴ The Confederation shall carry out surveys of the air pollution situation and trends in Switzerland as a whole (Article 39).⁴⁴

Art. 37⁴⁵ Market surveillance for construction machines and their particle filter systems, combustion installations and machinery

¹ The FOEN shall monitor compliance with the regulations concerning placing construction machines, particle filter systems, combustion installations and machinery on the market. It shall monitor in particular:

- a. whether the information given in the declaration of conformity is correct; or
- b. whether the engines of machinery which bear an approval mark conform to the type-approved engine or to the type-approved engine family.

² It may entrust control tasks to public entities and private specialist organisations.

³ If the installations controlled do not meet the requirements, the FOEN shall order the necessary measures. In serious cases, it may prohibit further offering or marketing, or request the modification of installations already marketed.

Art. 38 Thermal and motor fuels

¹ The customs authorities shall take samples of thermal and motor fuels which are imported or supplied by domestic refineries. They shall either submit the samples to a laboratory designated by the FOEN or analyse them themselves.⁴⁶

² The customs authorities or the laboratory shall report the results of the tests to the FOEN.⁴⁷

³ The FOEN shall verify compliance with the regulations on placing thermal and motor fuels on the market by testing samples.⁴⁸

⁴ If the FOEN establishes that an importer or dealer is repeatedly importing or placing on the market thermal or motor fuels which fail to meet the quality requirements in Annex 5, it shall inform the competent cantonal prosecution authorities and, if applicable, the customs authorities.⁴⁹

⁴⁴ Inserted by No I of the Ordinance of 18 June 2010, in force since 15 July 2010 (AS 2010 2965).

⁴⁵ Amended by No I of the Ordinance of 18 June 2010, in force since 15 July 2010 (AS 2010 2965).

⁴⁶ Amended by No I of the Ordinance of 23 June 2004, in force since 1 Jan. 2005 (AS 2004 3561).

⁴⁷ Amended by No I of the Ordinance of 23 June 2004, in force since 1 Jan. 2005 (AS 2004 3561).

⁴⁸ Amended by No I of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS 2015 4171).

⁴⁹ Inserted by No I of the Ordinance of 14 Oct. 2015 Nov, in force since 16 Nov. 2015 (AS 2015 4171).

Art. 39 Air pollution surveys

¹ The surveys of the air pollution situation and trends in Switzerland as a whole shall be carried out by the FOEN.

² The Swiss Federal Institute for Materials Testing and Research (EMPA) in Dübendorf shall operate the National Air Pollution Monitoring Network (NABEL) on behalf of the FOEN.

Art. 39a⁵⁰ Geoinformation

The FOEN shall specify the minimal geodata models and presentation models for official geodata in accordance with this Ordinance for which it is designated as the competent federal authority in Annex 1 of the Ordinance of 21 May 2008⁵¹ on Geoinformation.

Section 2 Amendment and Repeal of Existing Legislation**Art. 40**⁵²**Art. 41** Repeal of existing legislation

The Ordinance of 10 December 1984⁵³ on Air Pollution Control Measures for Combustion Installations is repealed.

Section 3 Transitional Provisions**Art. 42**

¹ Installations which require a construction permit or planning permission shall be regarded as new installations if no binding decision has been taken regarding the construction permit or planning permission at the time this Ordinance enters into force.

² Within two years after the commencement of this Ordinance, the authorities shall issue the retrofitting ruling in accordance with Articles 8 and 9, if possible for all cases, but at least for the most urgent cases where retrofitting is required.

³ In cases of existing excessive ambient air pollution levels, action plans shall be prepared in accordance with Article 31 within three years after the commencement of this Ordinance.

⁵⁰ Inserted by Annex 2 No 8 of the Ordinance of 21 May 2008 on Geoinformation, in force since 1 July 2008 (AS **2008** 2809).

⁵¹ SR **510.620**

⁵² Repealed by No IV 30 of the Ordinance of 22 Aug. 2007 on the Formal Revision of Federal Legislation, with effect from 1 Jan. 2008 (AS **2007** 4477).

⁵³ [AS **1984** 1516]

Section 4 Commencement

Art. 43

This Ordinance comes into force on 1 March 1986.

Final provisions of the Amendment of 20 November 1991⁵⁴

Final provisions of the Amendment of 15 December 1997⁵⁵

Final provisions of the Amendment of 25 August 1999⁵⁶

Final provisions of the Amendment of 30 April 2003⁵⁷

¹ Installations which require a construction permit or planning permission with regard to which no binding decision has been taken at the time this Amendment enters into force must comply with the requirements of the new legislation.

² Notwithstanding Article 10, the authorities shall grant time limits of five to ten years for the retrofitting of installations which become subject to mandatory retrofitting after 1 July 2003, but which already comply with the preventive emission limits based on the existing provisions. This is without prejudice to the provisions of Article 10 paragraph 2 letters a and c.

Final provisions of the Amendment of 23 June 2004⁵⁸

¹ Notwithstanding Article 10, the authorities shall grant time limits of six to ten years for the retrofitting of installations which become subject to mandatory retrofitting under the Amendment of 23 June 2004, but which already comply with the preventive emission limits based on the existing provisions. This is without prejudice to the provisions of Article 10 paragraph 2 letters a and c.

² ...⁵⁹

⁵⁴ AS 1992 124. Repealed by No IV 30 of the Ordinance of 22 Aug. 2007 on the Formal Revision of Federal Legislation, with effect from 1 Jan. 2008 (AS 2007 4477).

⁵⁵ AS 1998 223. Repealed by No IV 30 of the Ordinance of 22 Aug. 2007 on the Formal Revision of Federal Legislation, with effect from 1 Jan. 2008 (AS 2007 4477).

⁵⁶ AS 1999 2498. Repealed by No IV 30 of the Ordinance of 22 Aug. 2007 on the Formal Revision of Federal Legislation, with effect from 1 Jan. 2008 (AS 2007 4477).

⁵⁷ AS 2003 1345

⁵⁸ AS 2004 3561

⁵⁹ Repealed by No IV of the Ordinance of 14 Oct. 2015, with effect from 16 Nov. 2015 (AS 2015 4171).

³ Petrol and diesel oil which meet the existing requirements under Annex 5 of this Ordinance⁶⁰ may be placed on the market from licensed storage stocks, compulsory stocks and army stocks until 31 December 2008.

Final provisions of the Amendment of 4 July 2007⁶¹

¹ Notwithstanding Article 10, the authorities shall grant time limits of five to ten years for the retrofitting of installations which become subject to mandatory retrofitting under the Amendment of 4 July 2007, but which already comply with the preventive emission limits based on the existing provisions. For wood-fired installations they shall grant a time limit of ten years for retrofitting; this is without prejudice to the provisions of Article 10 paragraph 2 letters a and c.

² Combustion installations as specified in Article 20 paragraph 1 letter h may be placed on the market without a proof of conformity until 31 December 2007.

³ Wood-fired installations may be placed on the market without a proof of conformity until 31 December 2009 if they meet the requirements of Annex 4. In particular, these requirements are regarded as having been met in cases where wood-fired installations were awarded the Swiss Wood Energy Association (VHE) quality mark after 31 December 2003.

Transitional provisions relating to the Amendment of 19 September 2008⁶²

¹ The requirements specified in Annex 4 Number 3 apply to construction machines with a net power of 37 kW or more:

- a. manufactured between 2000 and 2008: from 1 May 2010, if they are operated on Measure-level A construction sites as defined in the FOEN Guidelines of 1 September 2002 on Air Pollution Control at Construction Sites;
- b. manufactured before 2000: from 1 May 2015.

² The requirements specified in Annex 4 Number 3 apply to construction machines with a net power of 18 kW to 37 kW manufactured in 2010 or later.

³ For particle filter systems which are included in the FOEN/SUVA Filter List at the time this Amendment enters into force, the requirements specified in Annex 4 Number 32 are regarded as having been met.

⁴ «Extra light» fuel oil which meets the existing requirements specified in Annex 5 may be placed on the market from licensed storage stocks, compulsory stocks and army stocks until 31 December 2011.

⁶⁰ AS 1999 2498

⁶¹ AS 2007 3875

⁶² AS 2008 4639

Transitional provisions relating to the Amendment of 18 June 2010⁶³

The requirements specified in Annex 4 Number 4 apply to machinery from 1 January 2011.

Transitional provisions relating to the Amendment of 14 October 2015⁶⁴

Notwithstanding Article 10, the authorities shall grant time limits of six to ten years for the retrofitting of stationary internal combustion engines and gas turbines which become subject to mandatory retrofitting in accordance with the Amendment of 14 October 2015, but which already comply with the preventive emission limits based on the existing provisions. This is without prejudice to the provisions of Article 10 paragraph 2 letters a and c.

⁶³ AS 2010 2965

⁶⁴ AS 2015 4171

General preventive emission limits

1 Scope

¹ The provisions of this Annex apply to the preventive limiting of emissions from stationary installations.

² They are without prejudice to the additional or different provisions applicable for:

- a. particular installations, as specified in Annex 2;
- b. combustion installations, as specified in Annex 3;
- c. type-approval of combustion installations, as specified in Annex 4.

2 Definitions

21 Exhaust gases

Exhaust gases means waste air, flue gases and other air pollutants discharged by installations.

22 Emissions

Emissions are expressed in the following terms:

- a. Concentration:
Mass of emitted substance in relation to the volume of exhaust gas (e.g. in milligrams per cubic metre [mg/m³]);
- b. Mass flow:
Mass of emitted substance per unit time (e.g. in grams per hour [g/h]);
- c. Emission factor:
Ratio of the mass of emitted substance to the mass of the products generated or processed (e.g. in kilograms per tonne [kg/t]);
- d. Emission ratio:
Ratio of the mass of an air polluting substance emitted to the mass of that substance supplied to the installation in fuels and feedstock (in % (m/m));
- e. Smoke number:
The degree of filter blackening caused by exhaust gases. The grey scale used to determine the Bacharach smoke number ranges from 0 to 9 in unit steps.

⁶⁵ Revised by No II of the Ordinances of 20 Nov. 1991 (AS **1992** 124), of 15 Dec. 1997 (AS **1998** 223) and of 23 June 2004 (AS **2004** 3561), No II 10 of the Ordinance of 18 May 2005 on the Repeal and Amendment of Ordinances in connection with the Commencement of the Chemicals Act (AS **2005** 2695), No II of the Ordinance of 4 July 2007 (AS **2007** 3875) and of 14 Oct. 2015, in force since 16 Nov. 2015 (AS **2015** 4171).

23 Reference value for emission concentrations

¹ The limit values expressed as concentrations and the oxygen contents given as reference values are based on the volume of exhaust gas under standard conditions (0 °C, 1013 mbar) after deduction of the moisture content (dry).

² The limit values expressed as emission concentrations are based on the amount of exhaust gas which is no more heavily diluted than is technically and operationally unavoidable.

³ If oxygen content by volume is given as the reference value for an installation listed in Annexes 2–4, the measured emission concentrations are to be corrected to this reference value.

24 Rated thermal input

The rated thermal input is the maximum thermal energy that can be supplied to an installation per unit time. It is obtained by multiplying the fuel consumption of the installation by the lower calorific value of the fuel.

3 General provisions

31 Limitation of emissions

¹ The following emission limitation requirements apply:

- a. for dust: Number 4;
- b. for inorganic substances, mainly in the form of dust: Number 5;
- c. for inorganic substances in gaseous or vaporous form: Number 6;
- d. for organic substances in gaseous, vaporous or particulate form: Number 7;
- e. for carcinogens: Number 8.

² Substances not listed in Numbers 5–8 shall be assigned to the substance classes which have comparable effects on the environment. Account shall be taken in particular of degradability and bio-accumulability, toxicity, the effects of decomposition processes and transformation products, and odour intensity.

32 Limitation of emissions dependent on installation size

¹ If there is more than one emission source and if emission limitation requirements depend on the size of an installation (e.g. capacity or mass flow), the authorities shall determine which emission sources shall collectively be considered to constitute a single installation.

² Emission sources are generally to be considered as a single installation if they are situated in close proximity to each other and if their emissions:

- a. essentially contain the same or similar pollutants; or

- b. can be reduced using the same technology.
- ³ Parts of an installation which only serve as back-ups in the event of malfunctions are not taken into account when determining the size of the installation.
- ⁴ Emission limit values which depend on a certain mass flow shall only apply if:
- a. this mass flow is reached or exceeded for more than five hours per week; or
 - b. double this mass flow is reached or exceeded for a shorter period.

4 Dust

41 Limit value for total dust

If the mass flow of dust is 0.20 kg/h or more, total dust emissions must not exceed 20 mg/m³.

42 Limitation of exposure to components of dust

The requirements specified in Numbers 5, 7 and 8 apply for the limitation of exposure to individual components of dust.

43 Measures relating to treatment, storage, transshipment and transport

- ¹ If significant dust emissions may occur in commercial or industrial facilities as a result of processes such as the conveyance, crushing, sorting or filling of dust-forming materials, the dust-containing exhaust gases must be captured and fed into a dust removal system.
- ² When dust-forming materials are stored or transshipped in the open, measures must be taken to prevent significant dust emissions.
- ³ When dust-forming materials are transported, transport equipment must be used which prevents significant dust emissions.
- ⁴ If traffic on factory roads may cause significant dust emissions, the roads must be kept free of dust.

5 Inorganic substances, mainly in the form of dust

51 Limit values

¹ The emission concentration of the substances listed in Number 52 must not exceed the following values:

- a. Class 1 substances
at a mass flow of 1 g/h or more 0.2 mg/m³
- b. Class 2 substances
at a mass flow of 5 g/h or more 1 mg/m³

- c. Class 3 substances
at a mass flow of 25 g/h or more 5 mg/m³

² The limit values apply to the total mass of an emitted substance, including gaseous and vaporous components in the exhaust gas.

³ If the exhaust gas contains several substances belonging to the same class, the limit value applies to the sum of these substances.

52 Table of inorganic substances, mainly in the form of dust

| Substance | | Expressed as | Class |
|------------------------|----------------------------------|------------------|-------|
| Antimony ¹ | and its compounds | Sb | 3 |
| Arsenic ¹ | and its compounds, except arsine | As | 2 |
| Chromium ¹ | and its compounds | Cr | 3 |
| Cobalt ¹ | and its compounds | Co | 2 |
| Copper | and its compounds | Cu | 3 |
| Cyanides ² | | CN | 3 |
| Fluorides ² | in dust form | F | 3 |
| Lead | and its compounds | Pb | 3 |
| Manganese | and its compounds | Mn | 3 |
| Mercury | and its compounds | Hg | 1 |
| Nickel ¹ | and its compounds | Ni | 2 |
| Palladium | and its compounds | Pd | 3 |
| Platinum | and its compounds | Pt | 3 |
| Rhodium | and its compounds | Rh | 3 |
| Silica dust | in fine crystalline form | SiO ₂ | 3 |
| Selenium | and its compounds | Se | 2 |
| Tellurium | and its compounds | Te | 2 |
| Thallium | and its compounds | Tl | 1 |
| Tin | and its compounds | Sn | 3 |
| Vanadium | and its compounds | V | 3 |

¹ If not listed as a carcinogenic compound under Number 8.

² If readily soluble.

6 Inorganic substances in gaseous or vaporous form

61 Limit values

The emission concentration of any of the substances listed in Number 62 must not exceed the following values:

- a. For a Class 1 substance
at a mass flow of 10 g/h or more 1 mg/m³

- | | | |
|----|---|-----------------------|
| b. | For a Class 2 substance at a mass flow of 50 g/h or more | 5 mg/m ³ |
| c. | For a Class 3 substance at a mass flow of 300 g/h or more | 30 mg/m ³ |
| d. | For a Class 4 substance at a mass flow of 2500 g/h or more | 250 mg/m ³ |

62 Table of inorganic substances in gaseous or vaporous form

| Substance | Class |
|--|-------|
| Ammonia and ammonium compounds, expressed as ammonia | 3 |
| Arsine | 1 |
| Bromine and its gaseous or vaporous compounds, expressed as hydrogen bromide | 2 |
| Chlorine | 2 |
| Chlorine compounds, vaporous or gaseous inorganic chlorine compounds except cyanogen chloride and phosgene, expressed as hydrogen chloride | 3 |
| Cyanogen chloride | 1 |
| Fluorine and its vaporous or gaseous compounds, expressed as hydrogen fluoride | 2 |
| Hydrogen cyanide | 2 |
| Hydrogen phosphide | 1 |
| Hydrogen sulphide | 2 |
| Nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide | 4 |
| Phosgene | 1 |
| Sulphur oxides (sulphur dioxide and sulphur trioxide), expressed as sulphur dioxide | 4 |

7 Organic substances in gaseous, vaporous or particulate form

71 Limit values

¹ The emission concentration of the substances listed in Number 72 must not exceed the following values:

- | | | |
|----|--|----------------------|
| a. | Class 1 substances at a mass flow of 0.1 kg/h or more | 20 mg/m ³ |
|----|--|----------------------|

- b. Class 2 substances
at a mass flow of 2.0 kg/h or more 100 mg/m³
- c. Class 3 substances
at a mass flow of 3.0 kg/h or more 150 mg/m³

² Notwithstanding paragraph 1, the provisions on dust limitation specified in Number 41 apply to Class 2 and Class 3 organic substances in particulate form.

³ If the exhaust gas contains several substances belonging to the same class, the limit value applies to the sum of these substances.

⁴ If the exhaust gas contains substances of different classes, the sum of the substances at a total mass flow of 3.0 kg/h or more must not exceed the limit value of 150 mg/m³, in addition to the requirements specified in paragraphs 1 and 2.

⁵ Emissions of substances for which there is good cause to believe that they are carcinogenic⁶⁶ and which are not listed as Class 1 substances in the Table under Number 72 must be controlled in accordance with paragraph 1 letter a.

⁶ Emissions of substances which are classified as ozone depleting substances in Annex 1.4 of the Ordinance of 18 May 2005⁶⁷ on Chemical Risk Reduction, but which are not listed as Class 1 substances in the Table under Number 72, must be controlled in accordance with paragraph 1 letter a. This is without prejudice to the provisions of Number 8.

72 Table of organic substances in gaseous, vaporous or particulate form

| Substance | Molecular formula | Class |
|---|--|-------|
| Acetaldehyde | C ₂ H ₄ O | 1 |
| Acetic acid | C ₂ H ₄ O ₂ | 2 |
| Acetic acid butyl ester (see Butyl acetate) | | |
| Acetic acid ethyl ester (see Ethyl acetate) | | |
| Acetic acid methyl ester (see Methyl acetate) | | |
| Acetic acid vinyl ester (see Vinyl acetate) | | |
| Acetic ester (see Ethyl acetate) | | |
| Acetone | C ₃ H ₆ O | 3 |
| Acrolein (see 2-Propenal) | | |

⁶⁶ Substances for which there is good cause to believe that they are carcinogenic means in particular those substances contained in Section III of the «List of MAK and BAT Values» (Maximum Concentrations and Biological Tolerance Values at the Workplace) issued by the German Research Foundation (DFG). Available from: VCH Verlags-AG, Postfach, CH-4020 Basel.

⁶⁷ SR 814.81

| Substance | Molecular formula | Class |
|--|--|-------|
| Acrylic acid | C ₃ H ₄ O ₂ | 1 |
| Acrylic acid ethyl ester (see Ethyl acrylate) | | |
| Acrylic acid methyl ester (see Methyl acrylate) | | |
| Alkanes, except methane | | 3 |
| Alkenes, except 1,3-butadiene and ethene | | 3 |
| Alkyl alcohols | | 3 |
| Alkyl lead compounds | | 1 |
| Aniline | C ₆ H ₇ N | 1 |
| Benzoic acid methyl ester (see Methyl benzoate) | | |
| Biphenyl | C ₁₂ H ₁₀ | 1 |
| Bis(2-ethylhexyl)phthalate (see Di(2-ethylhexyl)phthalate) | | |
| Bromomethane | CH ₃ Br | 1 |
| 2-Butanone | C ₄ H ₈ O | 3 |
| 2-Butoxyethanol | C ₆ H ₁₄ O ₂ | 2 |
| Butyl acetate | C ₆ H ₁₂ O ₂ | 3 |
| Butyl glycol (see 2-Butoxyethanol) | | |
| Butyraldehyde | C ₄ H ₈ O | 2 |
| Carbon disulphide | CS ₂ | 2 |
| Carbon tetrachloride (see Tetrachloromethane) | | |
| CFCs, chlorofluorocarbons, fully halogenated, with up to 3 C atoms | | 1 |
| Chloroacetaldehyde | C ₂ H ₃ ClO | 1 |
| Chlorobenzene | C ₆ H ₅ Cl | 2 |
| Chloroacetic acid | C ₂ H ₃ ClO ₂ | 1 |
| Chloroethane | C ₂ H ₅ Cl | 1 |
| Chloromethane | CH ₃ Cl | 1 |
| Chloroform (see Trichloromethane) | | |
| 2-Chloroprene (see 2-Chloro-1,3-butadiene) | | |
| 2-Chloropropane | C ₃ H ₇ Cl | 2 |
| Cresols | C ₇ H ₈ O | 1 |
| Cumene (see Isopropylbenzene) | | |
| Cyclohexanone | C ₆ H ₁₀ O | 1 |
| Diacetone alcohol (see 4-Hydroxy-4-methyl-2-pentanone) | | |

| Substance | Molecular formula | Class |
|---|-------------------|-------|
| Dibutyl ether | $C_8H_{18}O$ | 3 |
| 1,2-Dichlorobenzene | $C_6H_4Cl_2$ | 1 |
| 1,1-Dichloroethane | $C_2H_4Cl_2$ | 2 |
| 1,1-Dichloroethene | $C_2H_2Cl_2$ | 1 |
| 1,2-Dichloroethene | $C_2H_2Cl_2$ | 3 |
| Dichloromethane | CH_2Cl_2 | 1 |
| Dichlorophenols | $C_6H_4Cl_2O$ | 1 |
| Diethanolamine (see 2,2'-Iminodiethanol) | | |
| Diethylamine | $C_4H_{11}N$ | 1 |
| Diethyl ether | $C_4H_{10}O$ | 3 |
| Di(2-ethylhexyl)phthalate | $C_{24}H_{38}O_4$ | 2 |
| Diisopropyl ether | $C_6H_{14}O$ | 3 |
| Diisobutyl ketone (see 2,6-Dimethyl-4-heptanone) | | |
| Dimethylamine | C_2H_7N | 1 |
| Dimethyl ether | C_2H_6O | 3 |
| N,N-Dimethylformamide | C_3H_7NO | 2 |
| 2,6-Dimethyl-4-heptanone | $C_9H_{18}O$ | 2 |
| Dioctyl phthalate (see Di(2-ethylhexyl)phthalate) | | |
| 1,4-Dioxane | $C_4H_8O_2$ | 1 |
| Diphenyl (see Biphenyl) | | |
| Ethanol (see Alkyl alcohols) | | |
| Ethene | C_2H_4 | 1 |
| Ether (see Diethyl ether) | | |
| 2-Ethoxyethanol | $C_4H_{10}O_2$ | 2 |
| Ethyl acetate | $C_4H_8O_2$ | 3 |
| Ethyl acrylate | $C_5H_8O_2$ | 1 |
| Ethylamine | C_2H_7N | 1 |
| Ethylbenzene | C_8H_{10} | 2 |
| Ethyl chloride (see Chloroethane) | | |
| Ethylene glycol | $C_2H_6O_2$ | 3 |
| Ethylene glycol monobutyl ether (see 2-Butoxyethanol) | | |
| Ethylene glycol monoethyl ether (see 2-Ethoxyethanol) | | |
| Ethylene glycol monomethyl ether (see 2-Methoxyethanol) | | |

| Substance | Molecular formula | Class |
|--|--|-------|
| Ethyl glycol (see 2-Ethoxyethanol) | | |
| Ethyl methyl ketone (see 2-Butanone) | | |
| Formaldehyde | CH ₂ O | 1 |
| Formic acid | CH ₂ O ₂ | 1 |
| Formic acid dimethyl amide (see N,N-Dimethylformamide) | | |
| Formic acid methyl ester (see Methyl formate) | | |
| 2-Furaldehyde | C ₅ H ₄ O ₂ | 1 |
| Furfural (see 2-Furaldehyde) | | |
| Furfuryl alcohol | C ₅ H ₆ O ₂ | 2 |
| Glycol (see Ethylene glycol) | | |
| Halons, bromofluorocarbons, fully halogenated, with up to 3 C atoms | | 1 |
| HBFCs, hydrobromofluorocarbons, partially halogenated, with up to 3 C atoms | | 1 |
| HCFCs, hydrochlorofluorocarbons, partially halogenated, with up to 3 C atoms | | 1 |
| 4-Hydroxy-4-methyl-2-pentanone | C ₆ H ₁₂ O ₂ | 3 |
| 2,2'-Iminodiethanol | C ₄ H ₁₁ NO ₂ | 2 |
| Isopropenylbenzene | C ₉ H ₁₀ | 2 |
| Isopropylbenzene | C ₉ H ₁₂ | 2 |
| Maleic anhydride | C ₄ H ₂ O ₃ | 1 |
| Mercaptans (see Thiols) | | |
| Methacrylic acid methyl ester (see Methyl methacrylate) | | |
| Methanol (see Alkyl alcohols) | | |
| 2-Methoxyethanol | C ₃ H ₈ O ₂ | 2 |
| Methyl acetate | C ₃ H ₆ O ₂ | 2 |
| Methyl acrylate | C ₄ H ₆ O ₂ | 1 |
| Methylamine | CH ₅ N | 1 |
| Methyl benzoate | C ₈ H ₈ O ₂ | 3 |
| Methyl chloride (see Chloromethane) | | |
| Methyl chloroform (see 1,1,1,-Trichloroethane) | | |
| Methylcyclohexanone | C ₇ H ₁₂ O | 2 |
| Methylene chloride (see Dichloromethane) | | |
| Methyl ethyl ketone (see 2-Butanone) | | |

| Substance | Molecular formula | Class |
|--|-------------------|-------|
| Methyl formate | $C_2H_4O_2$ | 2 |
| Methyl glycol (see 2-Methoxyethanol) | | |
| Methyl isobutyl ketone (see 4-Methyl-2-pentanone) | | |
| Methyl methacrylate | $C_5H_8O_2$ | 2 |
| 4-Methyl-2-pentanone | $C_6H_{12}O$ | 3 |
| 4-Methyl-m-phenylene diisocyanate | $C_9H_6N_2O_2$ | 1 |
| N-Methyl pyrrolidone | C_5H_9NO | 3 |
| Naphthalene | $C_{10}H_8$ | 1 |
| Nitrobenzene | $C_6H_5NO_2$ | 1 |
| Nitrocresols | $C_7H_7NO_3$ | 1 |
| Nitrophenols | $C_6H_5NO_3$ | 1 |
| Nitrotoluenes, except 2-nitrotoluene | $C_7H_7NO_2$ | 1 |
| Olefin hydrocarbons (see Alkenes) | | 3 |
| Paraffin hydrocarbons (see Alkanes) | | 3 |
| Perchloroethylene (see Tetrachloroethylene) | | |
| Phenol | C_6H_6O | 1 |
| Phthalic acid dioctyl ester (see Di(2-ethylhexyl)phthalate) | | |
| Pinenes | $C_{10}H_{16}$ | 3 |
| 2-Propenal | C_3H_4O | 1 |
| Propionaldehyde | C_3H_6O | 2 |
| Propionic acid | $C_3H_6O_2$ | 2 |
| Pyridine | C_5H_5N | 1 |
| Styrene | C_8H_8 | 2 |
| 1,1,2,2-Tetrachloroethane | $C_2H_2Cl_4$ | 1 |
| Tetrachloroethylene | C_2Cl_4 | 1 |
| Tetrachloromethane | CCl_4 | 1 |
| Tetrahydrofuran | C_4H_8O | 2 |
| Thiols | | 1 |
| Thioether | | 1 |
| Toluene | C_7H_8 | 2 |
| Toluene diisocyanate (see 4-Methyl-m-phenylene diisocyanate) | | |
| Tolyene-2,4-diisocyanate (see 4-Methyl-m-phenylene diisocyanate) | | |

| Substance | Molecular formula | Class |
|--|--|-------|
| 1,1,1-Trichloroethane | C ₂ H ₃ Cl ₃ | 1 |
| 1,1,2-Trichloroethane | C ₂ H ₃ Cl ₃ | 1 |
| Trichloromethane | CHCl ₃ | 1 |
| Trichlorophenols | C ₆ H ₃ OC _l ₃ | 1 |
| Triethylamine | C ₆ H ₁₅ N | 1 |
| Trimethylbenzenes | C ₉ H ₁₂ | 2 |
| Vinyl acetate | C ₄ H ₆ O ₂ | 1 |
| Wood dust, respirable (except beech and oak wood dust) | | 1 |
| Xylenols, except 2,4-xylenol | C ₈ H ₁₀ O | 1 |
| 2,4-Xylenol | C ₈ H ₁₀ O | 2 |
| Xylenes | C ₈ H ₁₀ | 2 |

8 Carcinogens

81 Definition

Carcinogens means those substances which are designated as carcinogenic (C) in the list of limit values for exposure at the workplace⁶⁸ published by the Swiss Accident Insurance Fund (SUVA).

82 Limitation of emissions

¹ Irrespective of the risk of carcinogen exposure, emissions of carcinogens shall be limited as far as is technically and operationally feasible and economically acceptable.

² Emissions of the carcinogens listed in Number 83 shall be limited at least to such an extent that emission concentrations do not exceed the following values:

- a. Class 1 substances
at a mass flow of 0.5 g/h or more 0.1 mg/m³
- b. Class 2 substances
at a mass flow of 5 g/h or more 1 mg/m³
- c. Class 3 substances
at a mass flow of 25 g/h or more 5 mg/m³

³ If the exhaust gas contains several substances belonging to the same class, the limitation requirements specified in paragraph 2 apply to the sum of these substances.

⁶⁸ List of limit values for exposure at the workplace, available from: Schweizerische Unfallversicherungsanstalt SUVA, Postfach, 6002 Luzern.

83 Table of carcinogens

| Substance | Molecular formula | Class |
|---|--|-------|
| Acrylonitrile | C ₃ H ₃ N | 3 |
| Antimony trioxide (in respirable form), expressed as Sb | Sb | 2 |
| Arsenic trioxide and arsenic pentoxide, arsenious acid and its salts, arsenic acid and its salts (in respirable form), expressed as As | As | 2 |
| Asbestos (chrysotile, crocidolite, amosite, anthophyllite, actinolite, tremolite) in the form of fine dust | | 1 |
| Beech wood dust, respirable | | 3 |
| Benzene | C ₆ H ₆ | 3 |
| Benzo[a]pyrene | C ₂₀ H ₁₂ | 1 |
| Beryllium and its compounds in respirable form, expressed as Be | Be | 1 |
| Bromomethane | C ₂ H ₇ Br | 3 |
| 1,3-Butadiene | C ₄ H ₆ | 3 |
| Cadmium and its compounds cadmium chloride, cadmium oxide, cadmium sulphate, cadmium sulphide, and other bioavailable compounds (in respirable form), expressed as Cd | Cd | 1 |
| 2-Chloro-1,3-butadiene | C ₄ H ₅ Cl | 3 |
| 1-Chloro-2,3-epoxypropane | C ₃ H ₅ ClO | 3 |
| α-Chlorotoluene | C ₇ H ₇ Cl | 3 |
| α-Chlorotoluenes; mixtures of -chlorotoluene, α, α-dichlorotoluene, α, α, α-trichlorotoluene and benzyl chloride | | 3 |
| Chromium(VI) compounds (in respirable form) as calcium chromate, chromium(III) chromate, strontium chromate and zinc chromate, expressed as Cr | Cr | 2 |
| Cobalt (in the form of respirable dusts or aerosols of cobalt metal and poorly soluble cobalt salts), expressed as Co | Co | 2 |
| Dibenzo(a,h)anthracene | C ₂₂ H ₁₄ | 1 |
| 1,2-Dibromoethane | C ₂ H ₄ Br ₂ | 3 |
| 1,4-Dichlorobenzene | C ₆ H ₄ Cl ₂ | 3 |
| 3,3'-Dichlorobenzidine | C ₁₂ H ₁₀ N ₂ Cl ₂ | 2 |
| 1,2-Dichloroethane | C ₂ H ₄ Cl ₂ | 3 |
| Diesel soot | | 3 |
| Diethyl sulphate | C ₄ H ₁₀ O ₄ S | 2 |

| Substance | Molecular formula | Class |
|---|--|-------|
| Dimethyl sulphate | C ₂ H ₆ O ₄ S | 2 |
| Epichlorohydrin (see 1-Chloro-2,3-epoxypropane) | | |
| 1,2-Epoxypropane | C ₃ H ₆ O | 3 |
| Ethylene imine | C ₂ H ₅ N | 2 |
| Ethylene oxide | C ₂ H ₄ O | 3 |
| Hydrazine | H ₄ N ₂ | 3 |
| 2-Naphthylamine | C ₁₀ H ₉ N | 1 |
| Nickel (in the form of respirable dusts or aerosols of nickel metal, nickel sulphide and sulphide ores, nickel oxide and nickel carbonate, nickel tetracarbonyl), expressed as Ni | Ni | 2 |
| 2-Nitrotoluene | C ₇ H ₇ NO ₂ | 3 |
| Oak wood dust, respirable | | 3 |
| o-Toluidine | C ₇ H ₉ N | 3 |
| Trichlorethylene | C ₂ HCl ₃ | 3 |
| Vinyl chloride | C ₂ H ₃ Cl | 3 |
| N-Vinyl-2-pyrrolidone | C ₆ H ₉ NO | 3 |

*Annex 2*⁶⁹
(Art. 3 para. 2 let. a)

Additional or different emission limitation requirements for particular installations

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⁶⁹ Revised by No II of the Ordinance of 20 Nov. 1991 (AS **1992** 124), 15 Dec. 1997 (AS **1998** 223) Annex 2 No 5 of the Ordinance of 23 June 1999 on Plant Protection Products, (AS **1999** 2045), No II of the Ordinance of 30 Apr. 2003 (AS **2003** 1345), Annex 3 No II 5 of the Ordinance of 22 June 2005 on Movements of Waste (AS **2005** 4199), No II of the Ordinance of 4 July 2007 (AS **2007** 3875), of the Ordinance of 18 June 2010 (AS **2010** 2965), of 14 Oct. 2015 (AS **2015** 4171), Annex 6 No 7 of the Waste Ordinance of 4 Dec. 2015 (AS **2015** 5699) and No I of the Ordinance of 3 March 2017, in force since 1 Apr. 2017 (AS **2017** 715).

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1 Non-metallic mineral products**11 Cement and lime kilns****111 Fuels and waste**

¹ Number 81 does not apply to cement kilns.

² Waste may only be used in cement kilns if it is suitable for this purpose in accordance with Article 24 of the Waste Ordinance of 4 December 2015⁷⁰.

111^{bis} Reference value

Emission limit values are based on an exhaust gas oxygen content of 10 % (% vol).

112 Nitrogen oxides

Emissions of nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, shall be limited as far as is technically and operationally feasible and economically acceptable, but at least to 500 mg/m³.

113 Sulphur oxides

Emissions of sulphur oxides, expressed as sulphur dioxide, must not exceed 500 mg/m³.

114 Gaseous organic substances

¹ The emission limits in Annex 1 Number 7 do not apply.

² Emissions of gaseous organic substances are expressed as total carbon and must not exceed 80 mg/m³.

115 Dust

Dust emissions must not exceed 20 mg/m³.

116 Mercury and cadmium

Emissions of mercury and cadmium and compounds, expressed as metals, must not exceed 0.05 mg/m³ in either case.

⁷⁰ SR 814.600

117 Lead and zinc

Emissions of lead and zinc and compounds, expressed as metals, must not exceed 1 mg/m³ in total.

118 Dioxins and furans

Emissions of polychlorinated dibenzo-p-dioxins (dioxins) and dibenzofurans (furans) expressed as the sum of the toxicity equivalents in accordance with EN 1948-17¹ must not exceed 0.1 ng/m³.

119 Monitoring

¹ The exhaust gas content of the following must be continuously measured and recorded:

- a. nitrogen oxides;
- b. sulphur oxides;
- c. gaseous organic substances;
- d. dust.

² Any person who uses wastes containing organic compounds as a raw material in the production of cement must in addition to paragraph 1:

- a. continuously measure and record the benzene content in the exhaust gas;
- b. check each year in particular whether the emission limit values for benzo(a)pyrene and dibenzo(a,h)anthracene are being met.

12 Installations for firing ceramic products using clay**121 Reference value**

Emission limit values are based on an exhaust gas oxygen content of 18 % (v/v).

122 Fluorine compounds

¹ The emission limitation requirements specified for fluorine compounds in Annex 1 Numbers 5 and 6 do not apply.

² Emissions of fluorine compounds, expressed as hydrogen fluoride, must not exceed 250 g/h.

⁷¹ This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

123 Nitrogen oxides

Emissions of nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, shall be limited as far as is technically and operationally feasible and economically acceptable but, at a mass flow of 2000 g/h or more, at least to 150 mg/m³.

124 Organic substances

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of gaseous and vaporous organic substances shall be expressed as total carbon and must not exceed 100 mg/m³.

125 Relation to Number 81

The provisions of Number 81 apply.

13 Installations for the production of glass

131 Scope

The provisions of this Number apply to installations which produce more than 2 tonnes of glass per year.

132 Reference value

Emission limit values are based on the following flue gas oxygen contents:

- a. for flame-heated glass melting furnaces: 8 % (v/v)
- b. for flame-heated pot furnaces: 13 % (v/v)

133 Nitrogen oxides

¹ The emission limitation requirement specified for nitrogen oxides in Annex 1 Number 6 does not apply.

² Emissions of nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, shall be limited as far as is technically and operationally feasible and economically acceptable, but at least so that they do not exceed the following limit values:

- a. container glass: 2.5 kg per tonne of glass produced
- b. other glass: 6.5 kg per tonne of glass produced

134 ...

135 Sulphur oxides

Emissions of sulphur oxides from the raw material, expressed as sulphur dioxide, must not exceed 500 mg/m³.

136 Relation to Number 81

The provisions of Number 81 apply.

2 Chemistry

21 Installations for the production of sulphuric acid

211 Scope

The provisions of this Number apply to installations for the production of sulphur dioxide, sulphur trioxide, sulphuric acid and oleum.

212 Sulphur dioxide

¹ The emission limitation requirement specified for sulphur dioxide in Annex 1 Number 6 does not apply.

² Emissions of sulphur dioxide must not exceed 2.6 kg per tonne of 100 % sulphuric acid.

213 Sulphur trioxide

Emissions of sulphur trioxide must not exceed 60 mg/m³ under constant gas conditions, and 120 mg/m³ in all other cases.

22 Installations using the Claus process

221 Sulphur

The sulphur emission ratio must not exceed the following limit values:

| For installations with a production capacity of | Limit value in % (m/m) |
|---|------------------------|
| less than 20 t/day | 3.0 |
| 20–50 t/day | 2.0 |
| more than 50 t/day | 0.5 |

222 Hydrogen sulphide

¹ The exhaust gases shall be subjected to afterburning.

² Emissions of hydrogen sulphide must not exceed 10 mg/m³.

23 Installations for the production of chlorine**231 Chlorine**

¹ Emissions of chlorine must not exceed 3 mg/m³.

² In the case of installations for the production of chlorine with complete liquefaction, emissions of chlorine must not exceed 6 mg/m³.

232 Mercury

With alkali metal chloride electrolysis by the amalgam process, mercury emissions must not exceed an annual average of 1.5 g per tonne of installed chlorine capacity.

24 Installations for the production of 1,2-dichloroethane and vinyl chloride

¹ The exhaust gas shall be subjected to exhaust gas purification.

² The emission limitation requirement specified for 1,2-dichloroethane and vinyl chloride in Annex 1 apply irrespective of the mass flows specified therein.

25 ...**26 Production and packaging of plant protection products**

¹ Any person who produces or packages plant protection products must inform the cantonal environmental protection agency.

² The authorities shall specify preventive emission limitation requirements for total dust in accordance with Article 4; Annex 1 Number 41 does not apply.

27 Installations for the production of carbon black

Particulate emissions must not exceed a total of 20 mg/m³.

28 Installations for the production of carbon or electrographite by means of heating**281 Organic substances**

¹ Emissions of organic substances, expressed as total carbon, must not exceed the emission limitation requirements specified in Numbers 282–284.

² The emission limitation requirements specified in Annex 1 Number 7 do not apply.

282 Mixing and moulding

Emissions of organic substances in the exhaust gas of mixing and moulding installations where pitch, tar or other volatile binding agents or plasticisers are processed at a high temperature must not exceed 100 mg/m³.

283 Incineration

¹ Emissions of organic substances in the exhaust gas of single chamber furnaces, multi-chamber furnaces and tunnel furnaces must not exceed 50 mg/m³.

² Emissions of gaseous organic substances in the exhaust gas of ring furnaces for graphite electrodes, carbon electrodes and carbon bricks must not exceed 200 mg/m³.

284 Impregnation

Emissions of organic substances in the exhaust gas of impregnation installations which use tar-based impregnation agents must not exceed 50 mg/m³.

285 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

3 Mineral oil industry**31 Refineries****311 Definition and scope**

The provisions of this Number apply to installations for the distillation or refining of mineral oil and mineral oil products and to other installations for the production of hydrocarbons.

312 Refinery furnaces

312.1 Reference values

¹ The emission limit values are based on a flue gas oxygen content of 3% v/v.

² The emission limitation requirements for refinery furnaces are determined by the total rated thermal input of the refinery.

312.2 Sulphur oxides

Emissions of sulphur oxides, expressed as sulphur dioxide, must not exceed the following emission concentrations:

- a. with a rated thermal input of up to 300 MW: 350 mg/m³
- b. with a rated thermal input of more than 300 MW: 100 mg/m³

312.3 Nitrogen oxides

Emissions of nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, must not exceed 300 mg/m³.

313 Storage

¹ Floating-roof tanks, fixed-roof tanks with internal floating cover, fixed-roof tanks connected to the refinery gas line or equivalent measures shall be provided for the storage of crude oils and refining products which have a vapour pressure of more than 13 mbar at a temperature of 20 °C. Floating-roof tanks shall be equipped with effective seals.

² Fixed-roof tanks shall be equipped with forced ventilation, and the gases arising shall be fed to a gas collection or afterburning system if:

- a. liquids are stored which, under storage conditions, may emit Class 1 substances as specified in Annex 1 Number 7 or substances specified in Annex 1 Number 8; and
- b. the expected emissions exceed the mass flows specified in Annex 1.

314 Other emission sources

¹ Any organic gases or vapours released shall be collected using a gas collection system. They shall be reused, fed to a gas purification or afterburning system, or burnt off. This provision applies in particular to:

- a. pressure relief and blowdown systems;
- b. process plants;
- c. regeneration of catalysts;

- d. inspection and cleaning activities;
- e. start-up and shut-down processes;
- f. transfer of raw materials, intermediate products and finished products which have a vapour pressure of more than 13 mbar at a temperature of 20 °C.

² Emergency and fire relief systems are not required to be connected to a gas collection system.

315 Hydrogen sulphide

¹ Gases from desulphurisation installations and other sources shall be further processed if they simultaneously meet the following conditions:

- a. volume content of hydrogen sulphide more than 0.4 %
- b. mass flow of hydrogen sulphide more than 2 t/day

² Emissions of hydrogen sulphide in gases which are not further processed must not exceed 10 mg/m³.

316 Process water and ballast water

¹ Process water or excess ballast water must be degassed before it is discharged into an open system.

² The exhaust gases produced shall be purified by scrubbing or combustion.

32 Large storage tank installations

321 Definition and scope

The provisions of this Number apply to large storage tank installations with a capacity of more than 500 m³ per tank which are intended for the storage of products with a vapour pressure of more than 1 mbar at a temperature of 20 °C.

322 Storage

Fixed-roof tanks with internal floating cover, floating-roof tanks equipped with effective seals or other equivalent measures to reduce emissions shall be provided for storage.

33 Installations for transshipment of petrol

¹ The filling of road tankers, tank wagons or similar transport containers with automotive or aviation petrol must be carried out using bottom loading or other equivalent measures to reduce emissions.

² The emission limitation requirements specified in Annex 1 Numbers 7 and 8 do not apply to petrol stations.

³ Petrol stations shall be equipped and operated in such a way that:

- a. the organic gases and vapours displaced during delivery at the petrol station are collected and returned to the transport container (vapour recovery); the vapour recovery system and connected equipment shall not have any openings to the air during vapour recovery under normal operating conditions;
- b. when vehicles with standardised fuel tank filler pipes⁷² are filled, no more than 10 % of the organic substances contained in the displaced air shall be emitted; this requirement shall be deemed to be met if results to this effect are available from an official measurement agency and if the vapour recovery system is properly installed and operated.

⁴ The provisions of paragraph 3 letter b do not apply when low-volume dispensing devices are used for filling.

4 Metals

41 Foundries

411 Amines

Emissions of amines arising during core making must not exceed 5 mg/m³.

412 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

42 Cupolas

421 Dust

Total dust emissions must not exceed 20 mg/m³.

422 Carbon monoxide

Emissions of carbon monoxide in exhaust gas must not exceed 1000 mg/m³ for hot-blast furnaces with a recuperative heat exchanger.

⁷² ISO 13331

This standard may be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

423 Relation to Number 81

The provisions of Number 81 apply.

43 Aluminium smelters**431 Fluorine compounds**

¹ The emission limitation requirements specified for fluorine compounds in Annex 1 Numbers 5 and 6 do not apply.

² Emissions of fluorine compounds, expressed as hydrogen fluoride, must not exceed a total of 700 g per tonne of aluminium produced.

³ Emissions of gaseous fluorine compounds, expressed as hydrogen fluoride, must not exceed 250 g per tonne of aluminium produced.

432 Assessment of emissions

For comparison with the emission limit values, the measured emissions shall be averaged over an operating period of one month.

44 Installations for refining non-ferrous metals**441 Organic substances**

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of organic substances, expressed as total carbon, must not exceed 50 mg/m³.

442 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

45 Galvanising installations**451 Dust**

Total dust emissions must not exceed 10 mg/m³.

452 Additional provisions for hot-dip galvanising installations

¹ The emission limit values are based on an exhaust air volume of 3000 m³ per square metre of zinc bath surface area per hour.

² At least 80 % of emissions from the zinc bath shall be captured by enclosures, hoods, lip extraction systems or similar measures.

³ Emissions are only to be measured during dipping. Each dipping period begins with the first and ends with the last contact of the material to be galvanised with the galvanising bath.

46 Installations for the production of lead-acid batteries

461 Lead

¹ The exhaust gases from the installations shall be captured and fed into a dust removal system.

² Emissions of lead must not exceed 1 mg/m³.

462 Sulphuric acid vapours

¹ Sulphuric acid vapours generated during plate formation shall be captured and fed into an exhaust gas purification system.

² Emissions of sulphuric acid, expressed as H₂SO₄, must not exceed 1 mg/m³.

463 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

47 Heating furnaces and heat treatment furnaces

471 Scope

The provisions of this Number apply to heating furnaces and heat treatment furnaces with a rated thermal input of more than 100 kW which are fired with gaseous fuels as specified in Annex 5 Number 4 letters a–c.

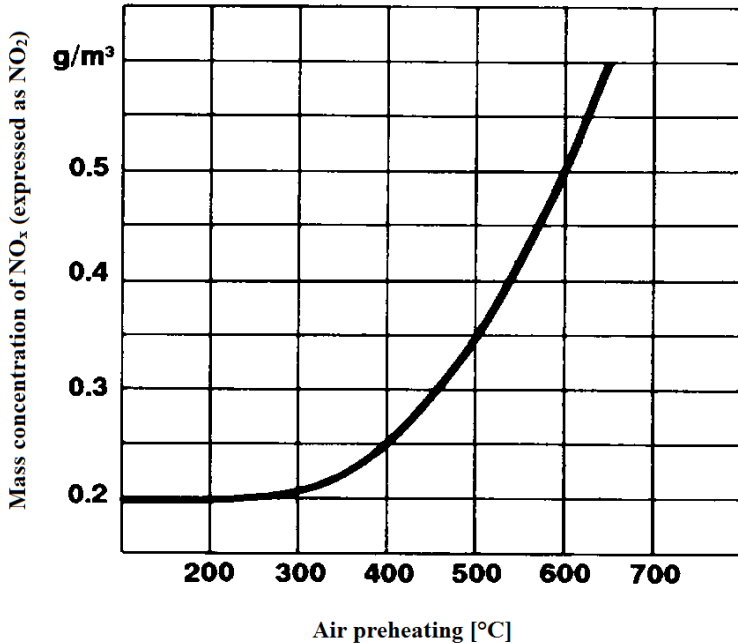
472 Reference value

The emission limit values are based on a flue gas oxygen content of 5 % (v/v).

473 Nitrogen oxides

Emissions of nitrogen oxides, expressed as nitrogen dioxide, must not exceed the limit values specified in the following diagram.

Diagram:



474 Measurements

Emissions shall be measured at not less than 80 % of the rated load and at the highest operating temperature in each case.

475 Relation to Number 81

The provisions of Number 81 apply.

48 Electric steel plants

481 Scope

The provisions of this number apply to installations for electric steel production, including continuous casting with a melting capacity of more than 2.5 tonnes of steel per hour.

482 Dust

Dust emissions must not exceed a total of 5 mg/m³.

483 Dioxins and furans

The emissions of polychlorinated dibenzo-p-dioxins (dioxins) and dibenzofurans (furans) produced in electric arc furnaces expressed as the sum of the toxicity equivalents in accordance with EN 1948-1⁷³, must not exceed 0.1 ng/m³.

5 Agriculture and foodstuffs**51 Stock rearing****511 Scope**

The provisions of this Number apply to installations for traditional stock rearing and intensive stock rearing.

512 Minimum distance

When installations are constructed, the minimum distances from residential areas required in accordance with the recognised rules of stock rearing shall be observed. These include, in particular, the recommendations of the Swiss Federal Research Station for Farm Management and Agricultural Engineering.⁷⁴

513 Ventilation systems

Ventilation systems must comply with the recognised rules of ventilation engineering. These include, in particular, the recommendations given in the Swiss Standard on Climatisation of Animal Houses.⁷⁵

52 Smoking installations**521 Scope**

The provisions of this Number apply to installations for smoking meat, sausages and fish.

⁷³ This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

⁷⁴ Available from: Forschungsanstalt Agroscope Reckenholz-Tänikon (ART), 8356 Ettenhausen.

⁷⁵ Available from: Institute of Plant, Animal and Agroecosystem Sciences, Universitätstr.2, CH-8092 Zürich, Switzerland.

522 Smoke production

Number 81 does not apply.

523 Organic substances

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of organic substances shall be expressed as total carbon. They must not exceed the following limit values:

- | | | |
|----|---|-----------------------|
| a. | For hot smoking at a mass flow of 50 g/h or more | 50 mg/m ³ |
| b. | For cold smoking at a mass flow of 50 g/h to 300 g/h | 120 mg/m ³ |
| c. | For cold smoking at a mass flow of over 300 g/h | 50 mg/m ³ |

53 Installations for rendering and for dung drying**531 Definition and scope**

The provisions of this Number apply to:

- rendering installations.
- installations where animal carcasses, parts of animal carcasses, and products of animal origin are collected and stored for use or disposal in rendering installations;
- installations for melting animal fats;
- installations for producing gelatin, haemoglobin and animal feed products;
- installations for dung drying.

532 Structural and operational requirements

¹ Processing installations and storage facilities where odours may develop shall be housed in closed rooms.

² Strong-smelling exhaust gases shall be captured and fed into an exhaust gas purification system.

³ Raw and intermediate products shall be stored in sealed containers.

533 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

54 Installations for drying green fodder**541 Scope**

The provisions of this Number apply to installations in which grass, maize plants and similar green fodder, marc, potatoes and sugar beet chips are dried.

542 Dust

Dust emissions shall be limited as far as is technically and operationally feasible and economically acceptable, but at least to 150 mg/m³.

543 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

55 ...**56 Installations for roasting coffee and cocoa****561 Organic substances**

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of gaseous and vaporous organic substances shall be expressed as total carbon. In the case of installations with a roasting capacity of more than 100 kg of raw product per hour, they must not exceed the following limit values:

- a. For installations with a roasting capacity of up to 750 kg/h: 150 mg/m³
- b. For installations with a roasting capacity of more than 750 kg/h: 50 mg/m³

562 Relation to Number 81

The provisions of Number 81 also apply to installations in which materials are treated by direct contact with furnace flue gases.

6 Coating and printing**61 Installations for coating and printing with organic substances****611 Scope**

¹ The provisions of this Number apply to:

- a. installations for coating and printing surfaces with organic substances such as paints, varnishes or plastics;

- b. installations for impregnation.

² They apply to the application and flash-off zones and also to the attached drying and stoving installations.

612 Dust

Total dust emissions must not exceed the following limit values:

- a. For spray painting: 5 mg/m³
- b. For powder coating: 15 mg/m³

613 Solvent emissions

¹ The emission limitation requirements specified in Annex 1 Number 71 do not apply to gaseous and vaporous organic emissions of Class 2 and Class 3 substances as specified in Annex 1 Number 72.

² These emissions shall be expressed as total carbon and at a mass flow of 3 kg/h or more they must not exceed a total of 150 mg/m³.

³ If paints are used which, in addition to water, exclusively contain up to 15% (m/m) ethanol as a solvent, emissions of ethanol must not exceed 300 mg/m³ at a mass flow of 3 kg/h or more.

614 Exhaust gases from drying and stoving installations

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply to drying and stoving installations in which drying or stoving is carried out at temperatures of more than 120 °C.

² Emissions of gaseous and vaporous organic substances shall be expressed as total carbon and at a mass flow of more than 250 g/h they must not exceed the following limit values:

- a. For web offset printing installations: 20 mg/m³
- b. For all other installations: 50 mg/m³

615 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

7 Waste**71 Installations for incineration of municipal and special waste****711 Scope and definitions**

¹ The provisions of this Number apply to installations in which municipal or special waste is incinerated or thermally decomposed. They are not applicable to installations for incinerating waste wood, paper and similar waste (Number 72) or sulphite waste liquor from pulp manufacture (Number 73), or to cement kilns (Number 11).

² *Municipal waste* means waste from households and other waste of similar composition. It includes in particular:

- a. garden waste;
- b. market waste;
- c. road sweepings;
- d. office waste, packaging and food waste from the catering industry;
- e. pre-treated municipal waste;
- f. animal carcasses and meat waste;
- g. sludge from municipal wastewater treatment plants;
- h. waste gases as defined in Annex 5 Number 41 paragraph 2;
- i. waste as defined in Annex 5 Number 31 paragraph 2 letter b.

³ *Special waste* means waste classified as special waste in the list issued in accordance with Article 2 of the Ordinance of 22 June 2005⁷⁶ on Movements of Waste (OMW).

712 Relation to Annex 1

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Where emission limitation requirements specified in Annex 1 apply, they apply irrespective of the mass flows specified therein.

713 Reference value and assessment of emissions

¹ The emission limit values are based on the following flue gas oxygen contents:

- | | |
|--|-----------|
| a. Plants for incinerating liquid waste: | 3% (v/v) |
| b. Plants for incinerating waste gases alone or together with liquid waste: | 3% (v/v) |
| c. Plants for incinerating solid waste alone or together with liquid waste or waste gases: | 11% (v/v) |

⁷⁶ SR 814.610

² For the assessment of emissions, the values obtained shall be averaged over an operating period of several hours.

714 Emission limit values

¹ Emissions must not exceed the following limit values:

- | | |
|--|-----------------------|
| a. Dust: | 10 mg/m ³ |
| b. Lead and zinc and their compounds, expressed as the metals, in total: | 1 mg/m ³ |
| c. Mercury and cadmium and their compounds, expressed as metals, in each case: | 0.1 mg/m ³ |
| d. Sulphur oxides, expressed as sulphur dioxide: | 50 mg/m ³ |
| e. Nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, at a mass flow of 2.5 kg/h or more: | 80 mg/m ³ |
| f. Gaseous inorganic chlorine compounds, expressed as hydrogen chloride: | 20 mg/m ³ |
| g. Gaseous inorganic fluorine compounds, expressed as hydrogen fluoride: | 2 mg/m ³ |
| h. Ammonia and ammonium compounds, expressed as ammonia: | 5 mg/m ³ |
| i. Gaseous organic substances, expressed as total carbon: | 20 mg/m ³ |
| k. Carbon monoxide: | 50 mg/m ³ |
| l. Polychloriated dibenzo-p-dioxins (dioxins) and dibenzofurans (furans), expressed as the sum of the toxic equivalents in accordance with EN 1948-1 ⁷⁷ | 0.1 ng/m ³ |

² For installations with a nitrogen oxide content (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, of 1000 mg/m³ or more in the raw gas, the authorities may specify a less strict emission limit value for ammonia and ammonium compounds, notwithstanding paragraph 1 letter h.

715 ...

716 Monitoring

¹ The following shall be continuously measured and recorded:

⁷⁷ This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

- a. the temperature of the flue gases around the burnout zone and in the stack;
- b. the oxygen content of the flue gases after they leave the burnout zone;
- c. the carbon monoxide content of the flue gases.

² Operation of the flue gas purification system shall be continuously monitored by measurement of an emission parameter or an appropriate operating parameter such as flue gas temperature, drop in pressure, or water flow rate of the flue gas scrubber.

717 Storage

Strong-smelling waste and waste which emits dangerous vapours shall be stored in closed bunkers, rooms or tank installations. The waste air shall be extracted and purified.

718 Prohibition on waste incineration in small installations

¹ Municipal and special waste must not be incinerated in installations with a rated thermal input of less than 350 kW.

² This prohibition does not apply to special waste from hospitals which, due to its composition, cannot be disposed of as municipal waste.

719 Incineration of particularly hazardous waste

¹ In cases where emissions may be especially hazardous to the environment, the installation owner shall determine the emissions to be expected by means of preliminary tests with small amounts of waste and shall inform the authorities of the results before the waste is incinerated.

² Emissions are regarded as particularly hazardous to the environment if they are both highly toxic and persistent, such as polyhalogenated aromatic hydrocarbons.

72 Installations for incineration of waste wood, paper and similar waste

721 Scope

¹ The provisions of this Number apply to installations in which waste made up of the following types of substances is incinerated or thermally decomposed alone or together with wood fuels as specified in Annex 5:

- a. waste wood as specified in Annex 5 Number 31 paragraph 2 letter a;
- b. paper and cardboard;
- c. other waste which, when incinerated, gives off emissions similar to those produced by the waste listed under letters a and b.

² If such waste is incinerated together with waste as specified in Number 711, the provisions of Number 71 apply.

³ The provisions of this Number do not apply to cement kilns (Number 11).

722 Reference value

The emission limit values are based on a flue gas oxygen content of 11% (v/v).

723 Dust

Dust emissions must not exceed the following limit values:

- a. For installations with a rated thermal input of up to 10 MW: 20 mg/m³
- b. For installations with a rated thermal input of more than 10 MW: 10 mg/m³

724 Lead and zinc

Combined emissions of lead and zinc must not exceed 5 mg/m³.

725 Organic substances

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of gaseous organic substances, expressed as total carbon, must not exceed 50 mg/m³.

726 Carbon monoxide and nitrogen oxides

¹ Emissions of carbon monoxide must not exceed 250 mg/m³.

² In the case of installations with a rated thermal input of more than 10 MW, emissions of nitrogen oxides, expressed as nitrogen dioxide, must not exceed 150 mg/m³.

727 Combustion control

The installation shall be operated with an automatic combustion control system.

728 Prohibition on waste incineration in small installations

Waste as specified in Number 721 must not be incinerated in installations with a rated thermal input of less than 350 kW.

73 Installations for incineration of sulphite waste liquor from pulp manufacture

731 Sulphur oxides

¹ The emission limitation requirement specified for sulphur oxides in Annex 1 Number 6 does not apply.

² Emissions of sulphur oxides, expressed as sulphur dioxide, must not exceed 4.0 kg per tonne of waste liquor incinerated.

732 Assessment of emissions

For comparison with the emission limit values, the measured emissions shall be averaged over an operating period of 24 hours.

74 Installations for incineration of biogenic waste and products of agriculture

741 Scope

¹ The provisions of this Number apply to installations in which solid biogenic waste and products of agriculture are incinerated or thermally decomposed alone or together with wood fuels as specified in Annex 5. Farmyard manure and other strong-smelling waste and products must not be either incinerated or thermally decomposed in such installations.

² If such waste and products are incinerated together with waste as specified in Number 711 or Number 721, the provisions of Number 71 or Number 72 apply.

³ If such waste and products are incinerated together with other fuels as specified in Annex 5, the composite limit value specified in Annex 3 Number 82 applies.

⁴ The provisions of this Number do not apply to cement kilns (Number 11).

742 Emission limit values

Emissions must not exceed the following limit values:

| | | Rated thermal input | | | |
|---|--|---------------------|--------------------------|---------------|-----|
| | | up to 1 MW | over 1 MW up to 10 MW | over 10 MW | |
| – Reference value: | | | | | |
| | The limit values are based on a flue gas oxygen content of | % (v/v) | 13 | 11 | 11 |
| – Total solids: | | mg/m ³ | 20 | 20 | 10 |
| – Carbon monoxide (CO) | | mg/m ³ | 500 | 250 | 150 |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide (NO ₂) ¹ | | mg/m ³ | 250 | 250 | 150 |

¹ At a mass flow of 2500 g/h or more

743 Prohibition on incineration in small installations

Solid biogenic waste and products of agriculture as specified in Number 741 must not be incinerated in installations with a rated thermal input of less than 70 kW.

8 Other installations**81 Installations in which products are treated by direct contact with furnace flue gases**

¹ Only fuels as specified in Annex 5 shall be used.

² For emissions of sulphur oxides from the fuel, Annex 1 Number 6 does not apply. If coal or «medium» or «heavy» fuel oil is used, emissions of sulphur oxides, expressed as sulphur dioxide, shall be limited to such an extent that they are no higher than the unabated emissions arising from the use of a fuel quality with a sulphur content of 1.0 % (m/m).

³ For emissions of sulphur oxides from the treated materials, Annex 1 Number 6 applies.

82 Stationary internal combustion engines**821 Reference value**

The emission limit values are based on an exhaust gas oxygen content of 5% (v/v).

822 Thermal and motor fuels

Stationary internal combustion engines may only be operated with gaseous thermal and motor fuels as specified in Annex 5 Number 4 or with liquid thermal and motor fuels that meet the requirements specified in Annex 5 Number 132.

823 Solids

¹ Particulate emissions must not exceed 10 mg/m³.

² For the internal combustion engines of emergency generators, Number 827 paragraph 2 applies.

824 Nitrogen oxides and carbon monoxide

¹ Emissions from stationary internal combustion engines must not exceed the following limit values:

| | | Rated thermal input | | |
|--|---|---------------------|-------------|-----------|
| | | Up to 100 kW | Over 100 kW | Over 1 MW |
| – Carbon monoxide (CO) | mg/m ³ | | | |
| | – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 paragraph 1 | 650 | 300 | 300 |
| | – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 paragraph 1 letters d and e, if these fuels make up at least 80 % of the fuels used for annual operation | 1300 | 650 | 300 |
| – when operating on liquid thermal or motor fuels | 650 | 300 | 300 | |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide (NO ₂) | mg/m ³ | | | |
| | – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 paragraph 1 | 250 | 150 | 100 |
| | – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 letters d and e, if these fuels make up at least 80 % of the fuels used for annual operation | 400 | 250 | 100 |
| | – when operating on liquid thermal or motor fuels | 400 | 250 | 250 |

² When operating a stationary internal combustion engine with a denitrification system, the emissions of ammonia and ammonia compounds, expressed as ammonia, must not exceed 30 mg/m³.

825 Test beds

For test beds for internal combustion engines, the authorities shall specify preventive emission limitation requirements in accordance with Article 4; Annex 1 and Annex 2 Numbers 821–824 do not apply.

826 Measurement and control

¹ Periodical measurement and control in accordance with Article 13 paragraph 3 must be repeated every two years.

² For internal combustion engines of emergency generators, Number 827 paragraph 3 applies.

827 Emergency generators

¹ For internal combustion engines of emergency generators that are operated for a maximum of 50 hours each year, the authority shall specify the preventive emission

limits in accordance with Article 4; Annex 1 Number 6, Annex 2 Number 824 and Annex 6 do not apply.

² Particulate emissions must not exceed 50 mg/m³.

³ Periodical measurement and control in accordance with Article 13 paragraph 3 must be repeated every six years.

83 Gas turbines

831 Reference value

The emission limit values are based on an exhaust gas oxygen content of 15% (v/v).

832 Fuels

Gas turbines may only be operated with gaseous thermal and motor fuels as specified in Annex 5 Number 4 or with liquid thermal and motor fuels that meet the requirements specified in Annex 5 Number 132.

833 Smoke number

When operating on liquid thermal or motor fuels, soot emissions must not exceed the smoke number 2 (Annex 1 Number 22).

834 Carbon monoxide

Emissions of carbon monoxide must not exceed the following limit values:

| | Rated thermal input | |
|---|---------------------|------------|
| | Up to 40 MW | Over 40 MW |
| – Carbon monoxide (CO) | mg/m ³ | |
| – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 paragraph 1 or liquid thermal or motor fuels | 100 | 35 |
| – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 paragraph 1 letters d and e, if these fuels make up at least 80 % of the fuels used for annual operation | 240 | 35 |

835 Sulphur oxides

Emissions of sulphur oxides, expressed as sulphur dioxide, must not exceed 120 mg/m³ at a mass flow of 2.5 kg/h or more.

836 Nitrogen oxides and ammonia

¹ Emissions of nitrogen oxides (nitrogen monoxide and nitrogen dioxide), expressed as nitrogen dioxide, must not exceed the following limit values:

| | Rated thermal input | |
|--|---------------------|------------|
| | Up to 40 MW | Over 40 MW |
| – Nitrogen oxides (NO _x) | mg/m ³ | |
| – when operating on gaseous thermal or motor fuels as specified in Annex 5 Number 41 paragraph 1 | 40 | 20 |
| – when operating on liquid thermal or motor fuels | 50 | 40 |

² When operating a gas turbine with a denitrification system, the emissions of ammonia and ammonia compounds, expressed as ammonia, must not exceed 10 mg/m³.

837 Test beds and emergency generators

¹ For test beds for gas turbines, the authorities shall specify preventive emission limitation requirements in accordance with Article 4; Annex 1 and Annex 2 Numbers 831–836 do not apply.

² For gas turbines of emergency generators which are operated for no more than 50 hours per year, the authorities shall specify preventive emission limitation requirements in accordance with Article 4; Annex 1 and Annex 2 Numbers 833, 834 and 836 do not apply.

84 Installations for the production of particle board

841 Scope

The provisions of this Number apply to installations in which particle board is produced using a dry process.

842 Dust

Dust emissions must not exceed the following limit values:

- a. in the exhaust gas of chip dryers: 50 mg/m³
- b. in exhaust gases of grinding machines: 10 mg/m³

843 Organic substances

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of gaseous and vaporous organic substances, measured at a temperature of 150 °C, shall be expressed as total carbon.

³ These emissions shall be limited as far as is technically and operationally feasible and economically acceptable, but at least to 350 g per tonne of wood used (absolutely dry).

844 Relation to Number 81

The provisions of Number 81 also apply to installations in which products are treated by direct contact with furnace flue gases.

85 Dry cleaning (clothes)

¹ The provisions of this Number apply to dry cleaning installations which are operated using halogenated hydrocarbons.

² The loading door of a dry cleaning machine shall be fitted with an interlock system so that it can only be opened when the concentration of gaseous and vaporous organic substances in the machine air falls below 2 g/m³.

³ The concentration specified for the interlock system in paragraph 2 shall be continuously monitored inside the machine around the loading door.

⁴ The dry-cleaned items must have a maximum temperature of 35 °C before being removed from the machine.

⁵ If exhaust air is extracted from the machine, it must be purified by means of an activated carbon filter or by equivalent measures.

⁶ Indoor air must be exhausted so that the operating areas are always kept under negative pressure.

86 Crematoria

861 Organic substances

¹ The emission limitation requirements specified in Annex 1 Number 7 do not apply.

² Emissions of gaseous and vaporous organic substances, expressed as total carbon, must not exceed 20 mg/m³.

862 Carbon monoxide

Emissions of carbon monoxide must not exceed 50 mg/m³.

87 Surface treatment installations

¹ The provisions of this Number apply to installations in which the surfaces of articles and products made of metal, glass, ceramics, plastics, rubber or other materials are treated with halogenated organic substances which at a pressure of 1013 mbar have a boiling point below 150 °C.

- ² Surface treatment installations shall be equipped and operated as follows:
- a. Articles and products must be treated in a chamber which is closed except for openings used for extraction of exhaust gases.
 - b. An interlock system shall be used to ensure that articles and products cannot be removed until the concentration of halogenated organic substances reaches 1 g/m^3 or less in the removal area.
 - c. Extracted exhaust gases must be cleaned in a separator. During this process, emissions of halogenated organic substances listed in Annex 1 Number 72 must not exceed a mass flow of 100 g/h and emissions of halogenated hydrocarbons listed in Annex 1 Number 83 must not exceed a mass flow of 25 g/h . The emission limitation requirements specified in Annex 1 Numbers 7 and 8 do not apply.
 - d. If halogenated organic substances are fed into or removed from the installation, emissions must be reduced by means of a vapour recovery system or equivalent measures.
- ³ If an installation is unable to meet the requirements specified in paragraph 2 letters a and b because of the bulky nature of the articles and products treated, emissions shall be reduced as far as is technically and operationally feasible and economically acceptable, by measures such as encapsulation, sealing, removal from exhaust air, airlocks or extraction.

88 Construction sites

¹ Emissions from construction sites shall be limited as far as is technically and operationally feasible and economically acceptable, particularly by limiting emissions from the machines and equipment used and appropriate operating procedures. Account shall be taken of the type, size and location of the construction site and the duration of construction work. The FOEN shall issue guidelines.

² The emission limit values specified in Annex 1 do not apply to construction machines and construction sites.

*Annex 3*⁷⁸
(Art. 3 para. 2 let. b)

Additional or different emission limitation requirements for combustion installations

1 Scope

¹ The provisions of this Annex apply to combustion installations which are used for the following purposes:

- a. space heating;
- b. production of process heat;
- c. production of warm or hot water;
- d. production of steam.

² They do not apply to combustion installations in which products are treated by direct contact with furnace flue gases.

2 General provisions

21 Fuels

In combustion installations as specified in Number 1, only fuels as specified in Annex 5 shall be burned.

22 Control of combustion installations

Periodic measurements in accordance with Article 13 paragraph 3 are not required for the following combustion installations:

- a. combustion installations which are operated for less than 100 hours in a calendar year;
- b. combustion installations with a rated thermal input of less than 12 kW which are used solely to heat individual rooms;
- c. ...
- d. ...
- e. coal-fired installations with a rated thermal input of less than 70 kW;

⁷⁸ Amended by No II of the Ordinance of 20 Nov. 1991 (AS **1992** 124). Revised by No II of the Ordinances of 15 Dec. 1997 (AS **1998** 223), 23 June 2004 (AS **2004** 3561), 4 July 2007 (AS **2007** 3875), 22 Oct. 2008 (AS **2008** 5163), the Ordinance of 18 June 2010 (AS **2010** 2965), 14 Oct. 2015 (AS **2015** 4171) and No. I of the Ordinance of 3 March 2017, in force since 1 Apr. 2017 (AS **2017** 715).

- f. wood-fired installations with a rated thermal input of less than 70 kW, provided they operate solely on wood fuels as specified in Annex 5 Number 31 paragraph 1 letter a, b or d number 1.

23 Measurement and assessment of emissions

¹ For each individual installation, emissions shall be measured under steady state conditions and in the load ranges which are relevant for assessment. In general, these are at least the highest and the lowest load point at which the installation is operated under standard operating conditions.

² For installations operated with soot blowing or similar cleaning processes, dust emissions shall be measured and assessed over a half-hour period. Measurement must include the cleaning phase.

3 Special provisions for combustion installations comprising several individual installations

¹ If several individual installations form a single operating unit, then limitation of emission for each individual installation is determined by the rated thermal input (Annex 1 Number 24) of the entire operating unit (total rated thermal input).

² The total rated thermal input is the sum of the rated thermal inputs of all the individual installations which make up the operating unit.

³ The following are exceptions to paragraphs 1 and 2:

- a. individual installations with a rated thermal input of up to 1 MW, provided that one or more other individual installations forming part of the operating unit operate on the same fuels;
- b. individual installations with a rated thermal input of up to 10 MW, provided that no other individual installations forming part of the operating unit operate on the same fuel.

4 Oil-fired installations

41 Combustion installations for «extra light» fuel oil

411 Emission limit values

¹ Emissions from combustion installations operating on «extra light» fuel oil must not exceed the following limit values:

Combustion installations for «extra light» fuel oil

- Reference value:
The limit values for gaseous pollutants are based on a flue gas oxygen content of 3% (v/v)
- Smoke number
 - a. installations with forced draught burners 1
 - b. installations with vaporising-type burners 2

| | |
|--|-----------------------|
| – Carbon monoxide (CO) | |
| a. installations with forced draught burners | 80 mg/m ³ |
| b. installations with vaporising-type burners fitted with a fan | 150 mg/m ³ |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide | |
| a. for installations listed in Article 20 | 120 mg/m ³ |
| b. for installations with a rated thermal input of more than 350 kW: | |
| – with a heating medium temperature of up to 110 °C | 120 mg/m ³ |
| – with a heating medium temperature of more than 110 °C | 150 mg/m ³ |
| – Ammonia and ammonium compounds, expressed as ammonia ¹ | 30 mg/m ³ |

¹ *Note:* This emission limitation requirement is only relevant for combustion installations fitted with a denitrification system.

² Emissions of sulphur oxides are limited by the maximum sulphur content specified in Annex 5 Number 11. The emission limitation requirement specified for sulphur oxides in Annex 1 Number 6 does not apply.

412 Additional provisions concerning nitrogen oxide emissions

¹ The authorities may specify less stringent limit values for combustion installations with a heating medium temperature of more than 150 °C in cases where compliance with the limit value of 150 mg/m³ specified for nitrogen oxides in Number 411 is not technically or operationally feasible, or is economically unacceptable. However, emissions of nitrogen oxides, expressed as nitrogen dioxide, must not exceed 250 mg/m³.

² The emission limit values for nitrogen oxides are based on an organically bound nitrogen content in the fuel of 140 mg/kg. If the nitrogen content is higher, emissions of nitrogen oxides, expressed as nitrogen dioxide, may be 0.2 mg/m³ higher per 1 mg nitrogen in the fuel; if the nitrogen content is lower, emissions of nitrogen oxides, expressed as nitrogen dioxide, must be 0.2 mg/m³ lower per 1 mg nitrogen in the fuel.

³ Notwithstanding the provisions of paragraph 2, the FOEN may specify a simplified assessment procedure for the initial measurement of installations as specified in Article 20 paragraph 1 and also for the periodic control of installations with a rated thermal input of up to 1 MW.

413 Incompletely combusted oil components

¹ The flue gases of combustion installations operating on «extra light» fuel oil must not contain any incompletely combusted oil components.

² The flue gases are generally regarded as free of incompletely combusted oil components if a periodic control demonstrates compliance with the limit values specified for carbon monoxide in Number 411. In the event of odour emissions, the authorities may carry out an additional oil test with solvents.

414 Energy requirements

¹ The flue gas losses from furnaces and boilers must not exceed the following limit values:

- a. For forced draught burners with single-stage operation and for vaporising-type burners 7 %
- b. For forced draught burners with two-stage operation:
 1. during first-stage operation 6 %
 2. during second-stage operation 8 %

² The authorities may specify less stringent limit values for furnaces and boilers where the shut-off temperature of the safety temperature limiter exceeds 110 °C and where compliance with the requirements specified in paragraph 1 is not technically or operationally feasible, or is economically unacceptable.

42 Combustion installations for «medium» and «heavy» fuel oil

421 Emission limit values

¹ Emissions from combustion installations operating on «medium» or «heavy» fuel oil must not exceed the following limit values:

| | Rated thermal input | | | |
|--|--------------------------|----------------------------|----------------|-----|
| | over 5 MW up to 50 MW | over 50 MW up to 100 MW | over 100 MW | |
| <i>«Medium» and «heavy» fuel oil</i> | | | | |
| – Reference value: The limit values are based on a flue gas oxygen content of | % (v/v) | 3 | 3 | 3 |
| – Total solids: for fuel oils with a sulphur content not exceeding 1% by mass: | mg/m ³ | 80 | 10 | 10 |
| – for other fuel oils | mg/m ³ | 50 | 10 | 10 |
| – Carbon monoxide (CO) | mg/m ³ | 170 | 170 | 170 |
| – Sulphur oxides (SO _x), expressed as sulphur dioxide (SO ₂) | mg/m ³ | 1700 | 1700 | 400 |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide (NO ₂) | mg/m ³ | 150 | 150 | 150 |
| – Ammonia and ammonium compounds, expressed as ammonia | mg/m ³ | 30 | 30 | 30 |

² The emission limit value of 1700 mg/m³ for sulphur oxides shall be deemed to be met if fuel oil with a sulphur content not exceeding 1 % by mass is used.

422 Use of «medium» and «heavy» fuel oil

«Medium» and «heavy» fuel oil must not be used in installations or operating units which have a rated thermal input of less than 5 MW for these fuels.

5 Coal- and wood-fired installations

51 Coal-fired installations

511 Emission limit values

¹ Emissions from combustion installations which operate on coal, coal briquettes or coke must not exceed the following limit values:

| | Rated thermal input | | | | | |
|---|---------------------|----------------------------------|---------------------------------|--------------------------------|----------------------------------|----------------|
| | up to 70 kW | over 70 kW up to 500 kW | over 500 kW up to 1 MW | over 1 MW up to 10 MW | over 10 MW up to 100 MW | over 100 MW |
| <i>Coal, coal briquettes, coke</i> | | | | | | |
| – Reference value: The limit values are based on a flue gas oxygen content of | % (v/v) | 7 | 7 | 7 | 7 | 7 |
| – Total solids: | mg/m ³ | | | | | |
| – from 1 September 2007 | mg/m ³ | | 150 | 150 | 50 | 10 |
| – from 1 January 2008 | mg/m ³ | – | 150 | 150 | 20 | 10 |
| – from 1 January 2012 | mg/m ³ | – | 50 | 20 | 20 | 10 |
| – Carbon monoxide (CO) | mg/m ³ | 4000 | 1000 | 1000 | 150 | 150 |
| – Sulphur oxides (SO _x), ex- pressed as sulphur dioxide (SO ₂): | | | | | | |
| – fluidised bed installations | mg/m ³ | – | – | – | 350 | 350 |
| – other coal-fired installa- tions | mg/m ³ | – | – | – | 1300 | 1300 |
| – other installations | mg/m ³ | – | – | – | 1000 | 1000 |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide (NO ₂) | mg/m ³ | – | – | – | 500 | 200 |
| – Ammonia and ammonium compounds, expressed as ammonia ¹ | mg/m ³ | 30 | 30 | 30 | 30 | 30 |

Notes:

- A dash in the table means that no limitations are specified either in Annex 3 or in Annex 1.
- ¹ This emission limitation requirement is only relevant for combustion installations fitted with a denitrification system.

² The authorities shall specify preventive emission limitation requirements for inorganic substances mainly in the form of dust and also for chlorine and fluorine compounds in accordance with Article 4; Annex 1 Number 5 and the emission limitation requirements specified for chlorine and fluorine compounds in Annex 1 Number 6 do not apply.

512 Measurement and control

For combustion installations with a rated thermal input of up to 70 kW, the emission limit value for carbon monoxide shall generally be deemed to be met if it is established that the installation is operated in accordance with the manufacturer's instruc-

tions regarding fuel and operation. If excessive smoke or odour pollution levels are suspected, the authorities may additionally order carbon monoxide measurements.

513 Use of coal

In combustion installations with a rated thermal input of less than 1 MW, only coal, coal briquettes or coke with a sulphur content not exceeding 1% (m/m) shall be used.

52 Wood-fired installations

521 Type of installation and fuel

¹ In wood-fired installations, only wood fuels as specified in Annex 5 Number 31 paragraph 1 may be used which are suitable for combustion in these installations on account of the fuel type, quality and moisture.

² In addition, only wood as specified in Annex 5 Number 31 paragraph 1 letters a, b or d number 1 may be used in hand-stoked combustion installations with a rated thermal input of up to 40 kW and in open fires.

³ In automatic combustion installations with a rated thermal input of up to 40 kW, only wood fuels as specified in Annex 5 Number 31 paragraph 1 letters a, b or d number 1 may be used.

522 Emission limit values

¹ Emissions from combustion installations operating on wood fuels as specified in Annex 5 Number 31 paragraph 1 must not exceed the following limit values:

| | Rated thermal input | | | | |
|--|---------------------|----------------------------------|---------------------------------|--------------------------------|---------------|
| | up to 70 kW | over 70 kW up to 500 kW | over 500 kW up to 1 MW | over 1 MW up to 10 MW | over 10 MW |

Wood fuels

| | | | | | | |
|---|-------------------|-------------------|-----------------|-----|-----|-----|
| – Reference value: The limit values are based on a flue gas oxygen content of | % (v/v) | 13 | 13 | 13 | 11 | 11 |
| – Total solids: | mg/m ³ | | 50 ^a | 20 | 20 | 10 |
| – Carbon monoxide (CO): | | | | | | |
| – for wood fuels as specified in Annex 5 Number 31 paragraph 1 letters a, b or d number 1 | mg/m ³ | 4000 ^b | 500 | 500 | 250 | 150 |
| – for wood fuels as specified in Annex 5 Number 31 paragraph 1 letters a, b or d number 1 | mg/m ³ | 1000 | 500 | 500 | 250 | 150 |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide (NO ₂) | mg/m ³ | c | c | c | c | 150 |

| | | Rated thermal input | | | | |
|---|-------------------|---------------------|----------------------------------|---------------------------------|--------------------------------|---------------|
| | | up to 70 kW | over 70 kW up to 500 kW | over 500 kW up to 1 MW | over 1 MW up to 10 MW | over 10 MW |
| – Gaseous organic substances, expressed as total carbon (C) | mg/m ³ | – | – | – | – | 50 |
| – Ammonia and ammonium compounds, expressed as ammonia ^d | mg/m ³ | – | – | – | 30 | 30 |

Notes:

- A dash in the table means that no limitations are specified either in Annex 3 or in Annex 1.
- ^a Solids limit value for hand-stoked boilers for wood fuels as specified in Annex 5 Number 31 paragraph 1 letters a, b or d number 1 with a rated thermal input of up to 120 kW: 100 mg/m³.
- ^b Does not apply to central heating cookers.
- ^c See the limit value specified for nitrogen oxides in Annex 1 Number 6.
- ^d This emission limitation requirement is only relevant for combustion installations fitted with a denitrification system.

² The above is without prejudice to the special requirements for new hand-stoked installations in accordance with Number 523.

³ The authorities shall specify preventive emission limitation requirements for chlorine compounds and for organic substances in gaseous, vaporous or particulate form in accordance with Article 4; the emission limitation requirements specified for chlorine compounds in Annex 1 Number 6 and those specified for organic substances in Annex 1 Number 7 do not apply.

523 Special requirements for hand-stoked installations

Hand-stoked boilers which cannot comply with the emission limit values specified in Number 522 at 30 % of nominal heat output must be fitted with a heat accumulator which can store at least half of the thermal energy produced per fuel load at nominal heat output.

524 Measurement and control

¹ For combustion installations with a rated thermal input of up to 70 kW, the emission limit value for carbon monoxide shall generally be deemed to be met if it is established that the installation is properly operated and only wood fuels as specified in Annex 5 Number 31 paragraph 1 letters a, b or d letter 1 are used. If the occurrence of smoke emissions or odour pollution is established or to be expected, the authorities may order emission measurements or other investigations.

² The assessment shall be based on average emissions over a half-hour period. The FOEN shall recommend suitable measurement and assessment methods.

6 Gas-fired installations

61 Emission limit values

Emissions from combustion installations operating on gaseous fuels must not exceed the following limit values:

Combustion installations for gaseous fuels

| | | |
|---|--|-----------------------|
| – Reference value: | | |
| The limit values are based on a flue gas oxygen content of | | 3% (v/v) |
| – Carbon monoxide (CO): | | |
| a. for installations listed in Article 20 paragraph 1 letters a–d | | 100 mg/m ³ |
| b. for combustion installations with a rated thermal input of over 350 kW: | | 100 mg/m ³ |
| – Nitrogen oxides (NO _x), expressed as nitrogen dioxide (NO ₂): | | |
| a. for installations listed in Article 20 paragraph 1 letters a–d | | |
| – atmospheric gas burners with a rated thermal input of up to 12 kW | | 120 mg/m ³ |
| – other installations | | 80 mg/m ³ |
| b. for combustion installations with a rated thermal input of over 350 kW: | | |
| – heating medium temperature of up to 110 °C | | 80 mg/m ³ |
| – heating medium temperature of over 110 °C | | 110 mg/m ³ |
| – Ammonia and ammonium compounds, expressed as ammonia ¹ | | 30 mg/m ³ |

¹ *Note:* This emission limitation requirement is only relevant for combustion installations fitted with a denitrification system.

62 Additional provisions concerning nitrogen oxide emissions

¹ The authorities may specify less stringent limit values for combustion installations with a heating medium temperature of more than 150 °C in cases where compliance with the limit value of 110 mg/m³ specified for nitrogen oxides in Number 61 is not technically or operationally feasible, or is economically unacceptable. However, emissions of nitrogen oxides, expressed as nitrogen dioxide, must not exceed 200 mg/m³.

² Notwithstanding the provisions of Number 61, the limit values for nitrogen oxides specified in Annex 3 Number 411 apply to gas-fired installations operating on gaseous fuels as specified in Annex 5 Number 41 letters b, d and e.

³ The emission limit values specified for nitrogen oxides in Annex 1 Number 6 and in Annex 3 Number 61 do not apply to installations listed in Article 20 paragraph 1 letters f and g; preventive emission control measures shall not be ordered in accordance with Article 4.

63 Energy requirements

¹ The flue gas losses from furnaces and boilers must not exceed the following limit values:

- | | |
|---|-----|
| a. For forced draught burners with single-stage operation and for gas burners | 7 % |
|---|-----|

- b. For forced draught burners with two-stage operation:
1. during first-stage operation 6 %
 2. during second-stage operation 8 %

² The authorities may specify less stringent limit values for furnaces and boilers where the shut-off temperature of the safety temperature limiter exceeds 110 °C and where compliance with the requirements specified in paragraph 1 is not technically or operationally feasible, or is economically unacceptable.

7 Combustion installations for liquid fuels as specified in Annex 5 Number 13

¹ The requirements specified in Number 41 apply to combustion installations which operate on liquid fuels as specified in Annex 5 Number 13.

² Fuels as specified in Annex 5 Number 13 must not be used in installations with a rated thermal input of less than 350 kW.

8 Multi- and mixed-fuel combustion installations

81 Multi-fuel combustion installations

If a single installation operates alternately on different kinds of fuel, the emission limitation requirements are determined by the fuel used in each case.

82 Mixed-fuel combustion installations

¹ If different kinds of fuel are burned at the same time in a single installation, the emission concentrations must not exceed the composite limit value.

² The composite limit value is calculated according to the following formula:

$$G_m = G_1 \times \frac{E_1}{E_{tot}} + G_2 \times \frac{E_2(21 - B_1)}{E_{tot}(21 - B_2)} + \dots + G_n \times \frac{E_n(21 - B_1)}{E_{tot}(21 - B_n)}$$

where:

G_m = composite limit value based on the oxygen content B_1

$G_1, G_2 \dots G_n$ = emission limit value for the various fuels⁷⁹

$E_1, E_2 \dots E_n$ = energy supplied per hour by the individual fuels

E_{tot} = $E_1 + E_2 + \dots E_n$

⁷⁹ *Note:* The following shall be taken as the emission limit values for sulphur dioxides:

- a. for «extra light» heating oil:
G = 330 mg/m³, based on a flue gas oxygen content of 3% (v/v);
- b. for gas:
G = 38 mg/m³, based on a flue gas oxygen content of 3% (v/v).

$B_1, B_2 \dots B_n$ = reference value (oxygen content on which the emission limit value for the first, second and subsequent fuels is based)

³ To calculate the relevant sulphur emission ratio, the method described in paragraph 2 shall be adopted *mutatis mutandis*.

Annex 4⁸⁰
(Art. 3 para. 2 let. c)

Requirements for combustion installations, construction machines and particle filter systems, and machinery

1 Scope

The provisions of this Annex apply to combustion installations as specified in Article 20 paragraph 1, construction machines and particle filter systems as specified in Article 19a and machinery as specified in Article 20b.

2 Requirements for combustion installations

21 Air pollution control requirements

211 Oil- and gas-fired installations

Oil- and gas-fired installations must comply with the air pollution control requirements of the relevant European standards, and the emission limit values given in the following Table.

| Type of installation | Relevant European standard ⁸¹ | Relevant emission class or emission limit value for nitrogen oxides (NO _x) and for carbon monoxide (CO) |
|---|--|---|
| Forced draught burners for «extra light» fuel oil (Article 20 paragraph 1 letter a) | EN 267 | NO _x class 3 CO class 3 |
| Gas-fired automatic forced draught burners (Article 20 paragraph 1 letter a) | EN 676 | NO _x class 3 CO: 100 mg/kWh |
| Boilers with forced draught burners for «extra light» fuel oil (Article 20 paragraph 1 letter c) | EN 303 and 304 | NO _x class 3 CO class 3 |
| Gas-fired boilers with forced draught burners (Article 20 paragraph 1 letter c) | EN 303 and 304 | NO _x class 3 CO: 100 mg/kWh |
| Gas-fired boilers and circulation heaters with atmospheric gas burners (Article 20 paragraph 1 letter d) | EN 297, EN 483, EN 625, EN 656, EN 677 | NO _x class 5 CO: 100 mg/kWh |

⁸⁰ Amended by No II of the Ordinance of 23 June 2004 (AS **2004** 3561). Revised by No II of the Ordinances of 4 July 2007 (AS **2007** 3875), 19 Sept. 2008 (AS **2008** 4639), 22 Oct. 2008 (AS **2008** 5163) the Ordinance of 18 June 2010 (AS **2010** 2965) No I and II of the Ordinance of 14 Oct. 2015 (AS **2015** 4171) and No III 1 of the Ordinance of 22 June 2016, in force since 1 Aug. 2016 (AS **2016** 2479). See also the Final Provisions and Transitional Provisions of the Amendments of 4 July 2007, 19 Sept. 2008 and 18 June 2010 above.

⁸¹ These standards may be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

| Type of installation | Relevant European standard ⁸¹ | Relevant emission class or emission limit value for nitrogen oxides (NO _x) and for carbon monoxide (CO) |
|---|--|--|
| Boilers and circulation heaters with vaporising-type «extra light» fuel oil burners (Article 20 paragraph 1 letter e) | EN 1, EN 303 and 304 | For installations with up to 30 kW rated thermal input: NO _x class 1 according to EN 1 CO: 150 mg/kWh For installations with over 30 kW rated thermal input: NO _x class 1 according to EN 1 CO: 60 mg/kWh |
| Direct gas-fired storage water heaters (boilers) (Article 20 paragraph 1 letter f) | EN 89 | NO _x class 5 |
| Gas-fired instantaneous water heaters (Article 20 paragraph 1 letter g) | EN 26 | |

212 Coal- and wood-fired installations

Coal- and wood-fired installations must comply with the air pollution control requirements of the relevant European standards, and the emission limit values given in the following Table.

| Type of installation | Relevant European standard ⁸² | Special requirements (emission limit values) ^a for carbon monoxide (CO) and solids (dust) | |
|--|--|--|---|
| | | From 1 January 2008 | From 1 January 2011 |
| Boilers fired by firewood and coal, hand stoked | EN 303-5 or EN 12809 | CO: 800 mg/m ³ Dust: 60 mg/m ³ | CO: 800 mg/m ³ Dust: 50 mg/m ³ |
| Boilers fired by wood chips and coal, automatically stoked | EN 303-5 or EN 12809 | CO: 400 mg/m ³ Dust: 90 mg/m ³ | CO: 400 mg/m ³ Dust: 60 mg/m ³ |
| Boilers fired by wood pellets, automatically stoked | EN 303-5 or EN 12809 | CO: 300 mg/m ³ Dust: 60 mg/m ³ | CO: 300 mg/m ³ Dust: 40 mg/m ³ |
| Room heaters for solid fuels | EN 13240 | CO: 1500 mg/m ³ Dust: 100 mg/m ³ | CO: 1500 mg/m ³ Dust: 75 mg/m ³ |
| Room heaters fired by wood pellets | EN 14785 | CO: 500 mg/m ³ Dust: 50 mg/m ³ | CO: 500 mg/m ³ Dust: 40 mg/m ³ |
| Residential cookers fired by solid fuel | EN 12815 | CO: 3000 mg/m ³ Dust: 110 mg/m ³ | CO: 3000 mg/m ³ Dust: 90 mg/m ³ |
| Central heating cookers fired by solid fuel | EN 12815 | CO: 3000 mg/m ³ Dust: 150 mg/m ³ | CO: 3000 mg/m ³ Dust: 120 mg/m ³ |
| Inset appliances and open fires fired by solid fuels | EN 13229 | CO: 1500 mg/m ³ Dust: 100 mg/m ³ | CO: 1500 mg/m ³ Dust: 75 mg/m ³ |

^a Reference oxygen content:
 – for wood-fired installations 13% (v/v);
 – for coal-fired installations 7% (v/v)

⁸² This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

22 ...

23 Markings

¹ The manufacturer shall affix to each combustion installation a readily visible, durable and clearly legible data plate/label which includes the information required by the relevant European standards, but at least the following details:

- a. name of the manufacturer or trademark of the installation;
- b. trade name, type designation or model number;
- c. number of the relevant European standard according to which the equipment was tested in accordance with Number 21;
- d. rated thermal input, nominal heat output/space heat output or corresponding output range in W or kW.

² The data plate/label of oil- and gas-fired installations must also indicate the NO_x class of the relevant European standard.

³ The data plate/label of wood- and coal-fired installations must also indicate the emission values for CO and dust in mg/m³, based on the relevant flue gas oxygen content, measured in accordance with Number 212.

3 Air pollution control requirements for construction machines and particle filter systems

31 Requirements for construction machines

¹ Emissions from construction machines must comply with the relevant requirements corresponding to the year of manufacture for non-road mobile machinery in accordance with Directive 97/68/EC⁸³.

² In addition, exhaust emissions from construction machines must not exceed the particle count of 1×10^{12} 1/kWh for solid particles with a diameter greater than 23 nm, determined in accordance with the best available technology, specifically the UNECE Particle Measurement Programme⁸⁴ and the test cycles specified in Directive 97/68/EC.

⁸³ OJ. L 59 of 27.02.1998, p. 1; last amended by Directive 2012/46/EU, OJ. L 353 of 06.12.2012, p. 80.

⁸⁴ UNECE Regulation No 49 of 15 Apr. 1982 on uniform provisions concerning the 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 fuelled with natural gas or liquefied petroleum gas for use in vehicles; last amended by the 04 series of amendments, addendum 8, in force since 22 Jan. 2015, Annex 4C, Particle Number Measurement Test Procedure. Available from: www.uncece.org. This regulation May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen.

³ The requirements specified in paragraph 2 are deemed to be complied with if the construction machine is operated with a particle filter system which meets the requirements specified in Number 32.

32 Requirements for particle filter systems

¹ Particle filter systems for construction machines must:

- a. filter 97 % of solid particles with a diameter of 20–300 nm when new and after 1000 hours of operation in a typical application (endurance test);
- b. filter 90 % of solid particles during regeneration;
- c. have an electronic on board control unit which records pressure losses that could compromise function and issues an alarm, and which switches off additive dosage in the event of filter damage;
- d. have an opacity coefficient of less than 0.15 m⁻¹ during free acceleration of the engine;
- e. be designed in such a way that it is impossible for the filter element to be installed in the reverse direction;
- f. be supplied with cleaning and maintenance instructions;
- g. be operated without additives containing copper or catalytic coatings containing copper in the exhaust treatment system; and
- h. limit the secondary emissions arising during operation as far as is technically and operationally feasible and economically acceptable.

² The measurement methods and test procedures shall be based on the best available technology, specifically in accordance with SN 277206⁸⁵ or UNECE Regulation No 132⁸⁶.

33 Markings

¹ The manufacturers or importers shall affix to each construction machine and particle filter system a readily visible, durable and clearly legible data plate/label including the following details:

- a. name of the manufacturer or importer;
- b. serial number;

⁸⁵ This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

⁸⁶ UNECE Regulation No 132 of 17 June 2014 on uniform provisions concerning the approval of Retrofit Emission Control devices (REC) for heavy duty vehicles, agricultural and forestry tractors and non-road mobile machinery equipped with compression ignition engines; revised by the 01 series of amendments, in force since 22 Jan. 2015 (Add.131 Rev.1). Available from: www.unece.org. This regulation May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen.

- c. type designation;
- d. name of the conformity assessment body, if assessment is a requirement.

² The data plate/label of construction machines shall also include the following details:

- a. year of manufacture of the construction machine;
- b. engine output in kW;
- c. type designation of the particle reduction system.

³ If a construction machine placed on the market is retrofitted with a particle filter system, the person installing this system shall affix to the construction machine a data plate/label including the details specified in paragraphs 1 and 2.

⁴ Construction machines with engines on the list of engine families in conformity with Article 19b paragraph 2 do not require a data plate/label on the particle filter system.

34 Exhaust emission maintenance and inspections

¹ The holder or operator of a construction machine must carry out exhaust emission maintenance or have such maintenance carried out at least every 24 months. It must retain the results of the exhaust emission maintenance for at least two years and present it to the authorities on request.

² Construction machines need not be inspected periodically in accordance with Article 13 paragraph 3. The authority shall carry out random checks of the results of exhaust emission maintenance. If there is any suspicion of excessive solid particle emissions, it may order further exhaust emission maintenance.

4 Air pollution control requirements for machinery

¹ The engines of machinery must comply with the relevant requirements specified for spark ignition engines for non-road mobile machinery in Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997⁸⁷ 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.

² The emission limitation requirements specified in Annex 1 do not apply.

⁸⁷ OJ L59 of 27.02.1998, p. 1, last amended by Directive 2010/26/EU, OJ L86 of 01.04.2010, p. 29.

Annex 5⁸⁸
(Art. 21 and 24)

Requirements for thermal and motor fuels

1 Fuel oils and other liquid fuels

11 Sulphur content of fuel oils

¹ The sulphur content of «extra light» fuel oil must not exceed 0.10% m/m.

² The sulphur content of «medium» and «heavy» fuel oil must not exceed 2.8% (m/m).

12 Additional requirements for fuel oils

¹ Additives containing halogen or heavy metal compounds (except iron compounds) must not be added to fuel oils.

² In addition, additives containing substances such as magnesium compounds which distort the results of smoke number measurement in the control of oil-fired installations must not be added to «extra light» fuel oil.

³ Waste oils must not be added to fuel oils.

13 Other liquid fuels

131 Definition

Other liquid fuels means liquid organic compounds which can be combusted like «extra light» fuel oil and meet the requirements specified in Number 132.

132 Requirements

¹ During combustion, other liquid fuels must not produce higher or other pollutant emissions than is the case with «extra light» fuel oil.

² The content of pollutants in the fuel must not exceed the following limit values:

| | |
|----------|----------|
| Ash | 50 mg/kg |
| Chlorine | 50 mg/kg |
| Barium | 5 mg/kg |
| Lead | 5 mg/kg |

⁸⁸ Revised by No II of the Ordinance of 20 Nov. 1991 (AS **1992** 124), No I of the Ordinance of 25 Aug. 1999 (AS **1999** 2498), No II of the Ordinance of 23 June 2004 (AS **2004** 3561), of 4 July 2007 (AS **2007** 3875), of 19 Sept. 2008 (AS **2008** 4639), of 18 June 2010 (AS **2010** 2965), 14 Oct. 2015 (AS **2015** 4171) and No I of the Ordinance of 3 March 2017, in force since 1 Apr. 2017 (AS **2017** 715). See also the Transitional Provisions of the Amendment of 19 Sept. 2008 above.

| | |
|---|----------|
| Nickel | 5 mg/kg |
| Vanadium | 10 mg/kg |
| Zinc | 5 mg/kg |
| Phosphorus | 5 mg/kg |
| Polychlorinated aromatic hydrocarbons (e.g. PCBs) | 1 mg/kg |

³ In derogation from paragraph 2, for liquid biogenic fuels the following values apply for ash and phosphorus:

| | |
|------------|-----------|
| Ash | 100 mg/kg |
| Phosphorus | 20 mg/kg |

133 Relation to Annex 2 Number 71

Other liquid organic compounds which do not meet the requirements specified in Number 132 shall be regarded as special waste.

2 Coal, coal briquettes and coke

The sulphur content of coal, coal briquettes and coke must not exceed 3.0 % (m/m).

3 Wood fuels

31 Definition

¹ *Wood fuels* means:

- a. untreated wood, in pieces, including attached bark, especially chopped firewood, wood briquettes, brushwood and cones, and unused sections of solid wood produced solely by mechanical processing;
- b. untreated wood, not in pieces, especially wood pellets, chips, shavings, sawdust, sander dust and bark;
- c. wood residues from the wood-processing industry and the woodworking trade, provided the wood is painted, coated, glued or treated in a similar way; the foregoing does not apply to wood that is pressure-impregnated or has halogenated organic compounds in the coating.
- d. untreated waste wood in the form of:
 1. fence posts, beanpoles and other items made of solid wood used in horticulture or agriculture,
 2. disposable pallets made of solid wood.

² Wood fuels do not include:

- a. waste wood from demolition, conversion or renovation work, waste residues from construction sites, used wooden furniture and waste wood from pack-

aging including pallets, with the exception of disposable pallets in accordance with paragraph 1 letter d number 2, or mixtures thereof with wood fuels as specified in paragraph 1;

- b. any other wooden materials, such as:
 - 1. waste wood or wood waste which has been pressure-impregnated with wood preservatives or treated with coatings containing halogenated organic compounds;
 - 2. wood waste or waste wood intensively treated with wood preservatives such as pentachlorophenol;
 - 3. such waste mixed with wood fuels as specified in paragraph 1 or with waste wood as specified in letter a.

32 Requirements for wood pellets and briquettes

Wood pellets and briquettes that are untreated wood in accordance with Number 31 paragraph 1 letters a and b may only be commercially imported or placed on the market if:

- a. the wood pellets meet the requirements of Standard SN EN ISO 17225-2 (Solid Biofuels - Fuel Specifications and Classes - Part 2: classification of wood pellets)⁸⁹ for Class A1 or A2 or are of an equivalent quality;
- b. the wood briquettes meet the requirements of Standard SN EN ISO 17225-3 (Solid Biofuels - Fuel Specifications and Classes - Part 3: classification of wood briquettes)⁹⁰ for Class A1 or A2 or are of an equivalent quality.

4 Gaseous fuels

41 Definition

¹ *Gaseous fuels* means:

- a. natural gas, petroleum gas or coal gas which is fed into a public gas distribution grid;
- b. liquid gas consisting of propane and/or butane;
- c. hydrogen;
- d. gases similar to natural gas, petroleum gas or coal gas, such as biogas from agriculture or sewage treatment gases;

⁸⁹ This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

⁹⁰ This standard May be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch.

- e. landfill gases, provided the total content of inorganic and organic chlorine and fluorine compounds, expressed as hydrogen chloride and hydrogen fluoride, does not exceed 50 mg/m³.

² All other gases shall be regarded as waste gases, which must meet the requirements specified in Annex 2 Number 71 during combustion. This also applies in particular to landfill gases which do not meet the requirements specified in paragraph 1 letter e.

42 Requirements

The sulphur content of gases as specified in Number 41 letters a and b must not exceed 190 mg/kg.

5 Petrols

¹ Petrol may only be imported or placed on the market if it complies with the following requirements:

| Property | Unit | Minimum value ^a | Maximum value ^a | Test method ^b |
|--|---------|----------------------------|----------------------------|---------------------------------|
| <i>Petrol</i> | | | | |
| – Research octane number, <i>RON</i> | | 95.0 ^c | – | EN ISO 5164 |
| – Motor octane number, <i>MON</i> | | 85.0 ^c | – | EN ISO 5163 |
| – Vapour pressure (DVPE): | | | | EN 13016-1 |
| – Six summer months | kPa | – | 60.0 ^d | |
| – Distillation characteristics: | | | | EN ISO 3405 |
| – evaporated at 100 °C | % (V/V) | 46.0 | – | |
| – evaporated at 150 °C | % (V/V) | 75.0 | – | |
| – Determination of hydrocarbon types: | | | | |
| – Olefins | % (V/V) | – | 18.0 | EN 15553, EN ISO 22854 |
| – Aromatics | % (V/V) | – | 35.0 | EN 15553, EN ISO 22854 |
| – Benzene | % (V/V) | – | 1.00 | EN 12177, EN 238, EN ISO 22854 |
| – Oxygen content | | | | EN 1601, EN 13132, EN ISO 22854 |
| – Oxygenates content: | | | | EN 1601, EN 13132, EN ISO 22854 |
| – Methanol | % (V/V) | – | 3.0 | |
| – Ethanol | % (V/V) | – | 10.0 | |
| – Isopropyl alcohol | % (V/V) | – | 12.0 | |
| – <i>tert</i> -Butyl alcohol | % (V/V) | – | 15.0 | |
| – Isobutyl alcohol | % (V/V) | – | 15.0 | |
| – Ethers (containing 5 or more carbon atoms) | % (V/V) | – | 22.0 | |
| – Other oxygenates ^c | % (V/V) | – | 15.0 | |
| – Sulphur content | mg/kg | – | 10.0 | EN ISO 20846, EN ISO 20884 |

| Property | Unit | Minimum value ^a | Maximum value ^a | Test method ^b |
|----------------|------|----------------------------|----------------------------|--------------------------|
| – Lead content | mg/l | – | 5.0 | EN 237 |

Notes:

- a The test results are to be assessed in accordance with EN ISO 4259 «Petroleum products – Determination and application of precision data in relation to methods of tests».
- b The following (joint) standards are applicable for testing:
- EN: standard issued by the European Committee for Standardization (CEN)
 - ISO: standard issued by the International Organization for Standardization (ISO).
These standards may be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch
- c For regular petrol, notwithstanding the values given in this Table, the RON must be at least 91 and the MON at least 81.
- d Applies to petrols used between 1 May and 30 September.
- e Other monoalcohols and ethers having a boiling point not greater than 210 °C

¹_{bis} If bioethanol is added to petrol, the following deviations from the maximum vapour pressure of 60.0 kPa specified in paragraph 1 are permissible during the six summer months, until 30 September 2020:

| Bioethanol content | % (V/V) | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 |
|--|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Maximum permissible deviation ^a | kPa | 3.7 | 6.0 | 7.2 | 7.8 | 8.0 | 8.0 | 7.9 | 7.9 | 7.8 | 7.8 |

Notes:

- a Intermediate values are obtained by linear interpolation between the value immediately above and the value immediately below the bioethanol content.

² Aviation petrol shall only be imported or placed on the market if the lead content does not exceed 0.56 g/L and the benzene content does not exceed 1 % (V/V). Aviation petrol placed on the market shall be dyed blue.

6 Diesel oil

Diesel oil shall only be imported or placed on the market if it complies with the following requirements:

| Property | Unit | Minimum value ^a | Maximum value ^a | Test method ^b |
|---|-------------------|----------------------------|----------------------------|--|
| – Cetane number | | 51.0 ^c | – | EN ISO 5165, EN 15195, EN 16144 |
| – Density at 15°C | kg/m ³ | – | 845.0 | EN ISO 3675, EN ISO 12185 |
| – Distillation characteristics: 95 % (V/V) recovered at | °C | – | 360 | EN ISO 3405, EN ISO 3924 |
| – Polycyclic aromatic hydrocarbons | % (m/m) | – | 8.0 | EN 12916 |
| – Sulphur content | mg/kg | – | 10.0 | EN ISO 20846, EN ISO 20884, EN ISO 13032 |

Notes:

- a The test results are to be assessed in accordance with EN ISO 4259 «Petroleum products – Determination and application of precision data in relation to methods of test».
 - b The following (joint) standards apply to testing:
 - EN: standard issued by the European Committee for Standardization (CEN)
 - ISO: standard issued by the International Organization for Standardization (ISO) These standards may be viewed free of charge at the Federal Office for the Environment, Worblentalstr. 68, 3063 Ittigen, or obtained for a fee from the Swiss Association for Standardization, Bürglistrasse 29, 8400 Winterthur, www.snv.ch
 - c For winter qualities, the cetane number, notwithstanding the value given in this Table, must at least satisfy the requirements of SN EN 590.
-

*Annex 6*⁹¹
(Art. 6 para. 3)

Minimum stack height

1 Scope

The provisions of this Annex apply to installations for which the quantity Q/S exceeds 5, where:

Q = mass flow of the emitted air pollutant in grams per hour;

S = value calculated in accordance with Number 9.

2 Calculation method

¹ The required physical stack height is calculated step by step in accordance with Numbers 3 to 6.

² If more than one air pollutant is emitted, the physical stack height is calculated on the basis of the pollutant for which the quantity Q/S has the highest value.

3 Parameter H_0

31 Determination of H_0 according to Diagram 1

¹ The parameter H_0 takes account of the short-term effects of the air pollutants emitted from a single installation. It is determined with the aid of Diagram 1.

² The quantities Q and F depend on the emission conditions at the installation. The full load values and the fuel/emission conditions most conducive to air pollution are used to calculate H_0 .

³ The quantity S is used to limit the maximum short-term ambient air pollution levels caused by the installation to a specific value (S value). The S values specified in Number 9 are used to calculate H_0 .

32 Determination of H_0 in individual cases

¹ The parameter H_0 is determined in individual cases according to the recognised rules for calculating the stack height and the dispersion of flue gases if:

- a. the Q/S or F values lie outside Diagram 1; or
- b. the flue gas temperature is less than 55 °C.

⁹¹ Revised by No II of the Ordinance of 15 Dec. 1997, in force since 1 March 1998 (AS 1998 223).

² However, where flue gas temperatures are below 55 °C, the parameter H_0 must not be lower than the value which is obtained according to Diagram 1 for a temperature of 55 °C.

4 Minimum height for flat, obstacle-free terrain

¹ The stack height for flat, obstacle-free terrain is:

$$H_1 = f \times H_0$$

The correction factor f takes account of long-term effects due to wind channelling.

² Values between 1.0 and 1.5 are used for f as follows:

$f = 1.00$ for sites with no prevailing wind direction;

$f = 1.25$ for sites with average conditions;

$f = 1.50$ for valleys with pronounced wind channelling.

³ Intermediate values are also possible for f , depending on the site conditions.

5 Height increase for buildings and vegetation

Elevated objects (buildings and vegetation) in the vicinity of the stack are taken into account by means of a height increase I_1 :

$$I_1 = g \times I$$

where:

$I =$ Height of the highest significant obstacle area in the region affected by the installation. Values between 0 (no obstacles) and 30 m (e.g. forest) are used for I .

$g =$ Correction factor, with values between 0 and 1 according to Diagram 2.

6 Physical stack height

The physical stack height H is calculated according to the following formula:

$$H = H_1 + I_1$$

7 More stringent requirements

In justified cases, the authorities will require taller stacks, for example, in the case of:

- a. structures with particular shapes;
- b. sites with particularly poor meteorological dispersion conditions;
- c. particular topographical conditions, such as narrow valleys, hillsides or depressions.

8 Symbols

| | | |
|-------------------------------------|---|---|
| H (m) | = | Physical stack height |
| H ₀ (m) | = | Parameter for determination of H ₁ |
| H ₁ (m) | = | Minimum stack height for flat, obstacle-free terrain |
| I (m) | = | Height of the highest significant obstacle area |
| I ₁ (m) | = | Height increase for buildings and vegetation |
| f (-) | = | Correction factor for long-term effects due to wind channelling |
| g (-) | = | Correction factor for buildings and vegetation |
| Q (g/h) | = | Mass flow of the emitted air pollutant; emissions of nitrogen oxides (nitrogen monoxide and nitrogen dioxide) are expressed as nitrogen dioxide |
| R _n (m ³ /h) | = | Volume flow of the flue gas under standard conditions (0 °C, 1013 mbar) |
| t (°C) | = | Flue gas temperature at the stack outlet |
| Δt (°C) | = | t-10 °C |
| F (m ⁴ /s ³) | = | Lift flux; $F = 3.18 \times 10^{-6} \times R_n \times \Delta t$ |
| S (μg/m ³) | = | S value (cf. Numbers 3 and 9) |

9 S values

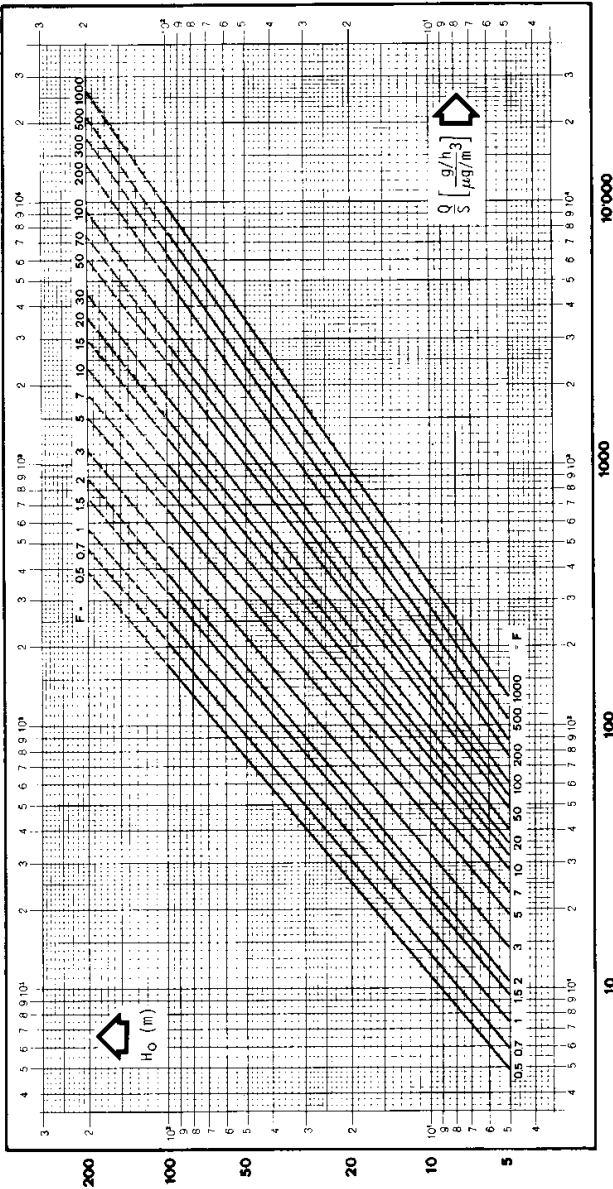
| Pollutant | S (μg/m ³) |
|---|------------------------|
| Suspended particulates (PM10) ¹ | 50 |
| Hydrogen chloride, expressed as HCl | 100 |
| Chlorine | 150 |
| Hydrogen fluoride and inorganic gaseous fluorine compounds, expressed as HF | 1 |
| Carbon monoxide | 8000 |
| Sulphur oxides, expressed as sulphur dioxide | 100 |
| Hydrogen sulphide | 5 |
| Nitrogen oxides, expressed as nitrogen dioxide | 100 |
| Substances listed in Annex 1 Number 5: | |
| – Class 1 | 0.5 |
| – Class 2 | 2 |
| – Class 3 | 5 |
| Substances listed in Annex 1 Number 7: | |
| – Class 1 | 50 |

| Pollutant | S ($\mu\text{g}/\text{m}^3$) |
|--|--------------------------------|
| – Class 2 | 200 |
| – Class 3 | 1000 |
| Substances listed in Annex 1 Number 8: | |
| – Class 1 | 0.1 |
| – Class 2 | 1 |
| – Class 3 | 10 |

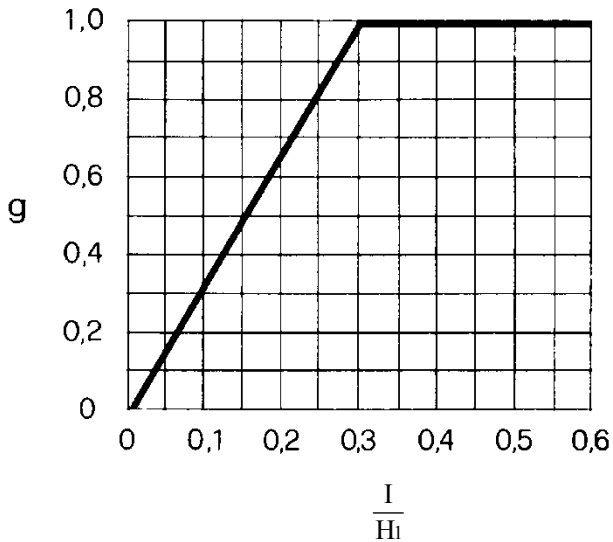
¹ Fine particulate matter with an aerodynamic diameter of less than 10 μm .

Determination of the parameter H_0 for stacks

Diagram 1



$$F = 3,18 \times 10^{-6} \times R_n \times \Delta t \quad \Delta t = t - 10^\circ C$$

Determination of the correction factor for buildings and vegetation*Diagram 2*

I = Height of the highest significant obstacle area (Number 5)

H_1 = Minimum stack height for flat, obstacle-free terrain (Number 4)

*Annex 7*⁹²
(Art. 2 para. 5)

Ambient limit values for air pollutants

| Pollutant | Ambient air limit value | Statistical definition |
|---|-------------------------|--|
| Sulphur dioxide (SO ₂) | 30 µg/m ³ | Annual average (arithmetic mean) |
| | 100 µg/m ³ | 95% of half-hour means for one year ≤ 100 µg/m ³ |
| | 100 µg/m ³ | 24-hour mean; must not be exceeded more than once per year |
| Nitrogen dioxide (NO ₂) | 30 µg/m ³ | Annual average (arithmetic mean) |
| | 100 µg/m ³ | 95% of half-hour means for one year ≤ 100 µg/m ³ |
| | 80 µg/m ³ | 24-hour mean; must not be exceeded more than once per year |
| Carbon monoxide (CO) | 8 mg/m ³ | 24-hour mean; must not be exceeded more than once per year |
| Ozone (O ₃) | 100 µg/m ³ | 98% of half-hour means for one month ≤ 100 µg/m ³ |
| | 120 µg/m ³ | 1-hour mean; must not be exceeded more than once per year |
| Suspended particulates (PM ₁₀) ¹ | 20 µg/m ³ | Annual average (arithmetic mean) |
| | 50 µg/m ³ | 24-hour mean; must not be exceeded more than once per year |
| Lead (Pb) in PM ₁₀ | 500 ng /m ³ | Annual average (arithmetic mean) |
| Cadmium (Cd) in PM ₁₀ | 1.5 ng/m ³ | Annual average (arithmetic mean) |

⁹² Amended by No II of the Ordinance of 14 Oct. 2015, in force since 16 Nov. 2015 (AS 2015 4171).

| Pollutant | Ambient air limit value | Statistical definition |
|-------------------------------|-----------------------------|-------------------------------------|
| Total dust deposition | 200 mg/m ² × day | Annual average (arithmetic mean) |
| Lead (Pb) in dust fallout | 100 µg/m ² × day | Annual average (arithmetic mean) |
| Cadmium (Cd) in dust fallout | 2 µg/m ² × day | Annual average (arithmetic mean) |
| Zinc (Zn) in dust fallout | 400 µg/m ² × day | Annual average (arithmetic mean) |
| Thallium (Tl) in dust fallout | 2 µg/m ² × day | Annual average (arithmetic mean) |

Notes:

mg = milligram: 1 mg = 0.001 g
 µg = microgram: 1 µg = 0.001 mg
 ng = nanogram: 1 ng = 0.001 µg
 d = day

The sign ≤ means «less than or equal to».

¹ Fine particulate matter with an aerodynamic diameter of less than 10 µm.

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