DURAG GROUP

GUIDANCE BOOK

on European Directive 2010/75/EU IED (Industrial Emissions Directive)
under the influence of the new European standards

TECHNOLOGY FOR A CLEAN AND SAFE ENVIRONMENT

ON EUROPEAN DIRECTIVE 2010/75/EU IED (INDUSTRIAL EMISSIONS DIRECTIVE) UNDER THE INFLUENCE OF THE NEW EUROPEAN STANDARDS

- DIRECTIVE 2010/75/EU OF 24 NOVEMBER 2010 ON INDUSTRIAL EMISSIONS (INTEGRATED POLLUTION PREVENTION AND CONTROL) (IED)
- EUROPEAN STANDARD EN 14181 STATIONARY SOURCE EMISSIONS – QUALITY ASSURANCE OF AUTOMATED MEASURING SYSTEMS
- EUROPEAN STANDARD EN 15267 AIR QUALITY – CERTIFICATION OF AUTOMATED MEASURING SYSTEMS
- EUROPEAN STANDARD EN 17255 STATIONARY SOURCE EMISSIONS – DATA ACQUISITION AND HANDLING SYSTEMS

0 | CONTENTS

CONTENTS

PREFACE

This guidance book contains legal obligations for plants pursuant to Directive 2010/75/EU of 24 November 2010 (IED) and Directive 2015/2193/EU of 25 November 2015 (MCP) – as well as requirements for continuous emission and evaluation systems.

Please read the guidance book if you require the following information:

- Answers to questions concerning the European directives for large or medium combustion plants
- Information on EN 14181 – Quality assurance of automated measuring systems (AMS)
- Information on minimum requirements
- Explanations of abbreviations
- Links and source references for your own research and detailed information
- Application examples and a DURAG GROUP product overview (at the end of this guidance book)

DURAG GROUP has been committed for years to making your everyday working life a little easier with this guidance book. Thank you for your interest.

1 | THE EUROPEAN DIRECTIVES + STANDARDIZATION

THE EUROPEAN DIRECTIVES + STANDARDIZATION

DIRECTIVE 2010/75/EU – THE INDUSTRIAL EMISSIONS DIRECTIVE OR IED

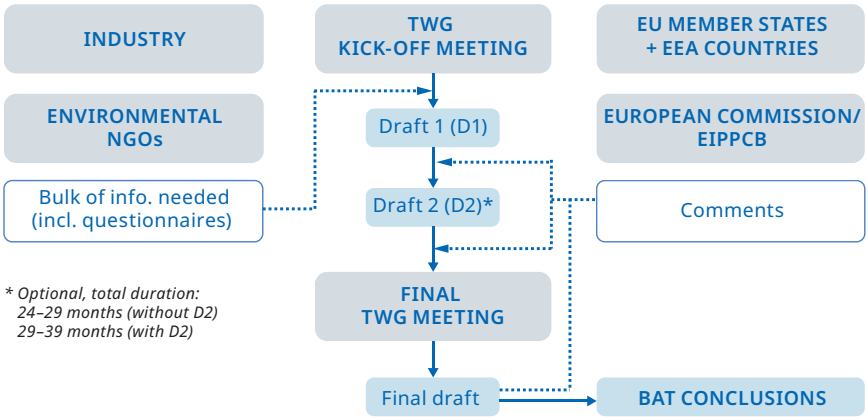
Directive 2010/75/EU of the European Parliament and the Council on industrial emissions – the Industrial Emissions Directive or IED – is the main EU instrument regulating pollutant emissions from industrial installations. The IED was adopted on 24 November 2010. It is based on a Commission proposal recasting 7 previously existing directives (including in particular the IPPC Directive). The IED entered into force on 6 January 2011 and had to be transposed by Member States by 7 January 2013.

More than 52,000 (agro)industrial installations undertaking the industrial activities listed in Annex I of the IED are required to operate in accordance with a permit (granted by the authorities in the Member States).

The permit conditions including emission limit values must be based on the best available techniques (BAT).

In order to define BAT and BAT-associated environmental performance at EU level, the Commission organizes an exchange of information with experts from Member States, industry and environmental organizations. This work is coordinated by the European IPPC Bureau at the EU Joint Research Centre in Seville (Spain) and is called the "Sevilla Process". This process results in BAT reference documents (BREFs); the BAT conclusions contained are adopted by the Commission as Implementing Decisions. The IED requires that these BAT conclusions are the reference for setting permit conditions. To achieve this, experts from Member States, industry, environmental NGOs and services of the Commission together discuss every detail of these norms. This participatory, rigorous and transparent approach is known internationally as the Sevilla Process.

For each BREF, the European IPPC Bureau sets up a Technical Working Group (TWG) to carry out the exchange of information on BAT. A TWG usually consists of between 100 and 200 experts.



** Optional, total duration:*
24–29 months (without D2)
29–39 months (with D2)

BAT reference documents (BREFs) represent the outcome of the Sevilla process. The majority of BREFs cover specific agro-industrial activities; such BREFs are referred to as "sectoral BREFs". However, there are also a number of "horizontal BREFs" dealing with cross-cutting issues such as energy efficiency, industrial cooling systems or emissions from storage with relevance for industrial manufacturing in general. A specific BREF was developed for the monitoring of emissions to air and water from installations under the Industrial Emissions Directive, which is referred to as the "ROM". The "BAT conclusions" is a document containing the parts of a BREF laying down the conclusions on best available techniques. According to Article 14(3) of the IED, BAT conclusions must be the reference for setting emission limits and issuing operating permits for large (agro) industrial installations covered under Annex I of the Industrial Emissions Directive.

As of 2023, the European IPPC Bureau has issued 35 BREFs, some of them have been already reviewed and updated. One can retrieve and download the current versions of the existing BREFs from BAT reference documents, Eippcb (europa.eu). This website also provides information about the status of each BREF.

In many countries, BAT are used to derive BAT-associated environmental performance levels (BAT-AEPLs). These encompass BAT-associated emission levels (BAT-AELs) as well as other environmental performance levels. BAT-AELs are – according to the European Union's Industrial Emissions Directive (IED) – "the range of emission levels obtained under normal operating conditions using a best available technique or a combination of best available techniques expressed as an average over a given period of time, under specified reference conditions". The BAT-AELs are technologically driven; i.e. they reflect the environmental performance levels that can be achieved by implementing BAT or a combination of BAT, rather than being based, for example, on national emission targets and/or on the whole operating range of current performance of all installations. It is the obligation of the EU Member States to determine related specific limit values. A specific BREF was developed for the monitoring of emissions to air and water from installations under the Industrial Emissions Directive, which is referred to as the "ROM".
For certain activities, i.e. large combustion plants or waste incineration and co-incineration plants, the IED also sets EU wide emission limit values for selected pollutants.

The European Commission's proposal for a revision, tabled in April 2022, seeks to bring it into line with the EU's zero pollution ambition, energy, climate and circular economy policy goals under the European Green Deal.

On 29 November 2023, the Council and the European Parliament's negotiators reached a provisional political agreement on the revision of the directive on industrial emissions (IED) and the regulation on the establishment of an industrial emissions portal (IEP).

The new rules aim to offer better protection of human health and the environment by reducing harmful emissions from industrial installations, including intensive livestock farms, into the air, water and soil and through waste discharges. They also aim to improve environmental data reporting by upgrading the existing European pollutant release and transfer register (E-PRTR) in order to establish a more comprehensive and integrated industrial emissions portal. The deal is provisional pending formal adoption by both institutions.

Parliament adopted on 12 March 2024 the deal with member states on the revision of the industrial emission directive (IED) and the new regulation on the Industrial Emissions Portal.

NEXT STEPS

The law now also has to be adopted by Council, before being published in the EU Official Journal and entering into force 20 days later. Member states will then have 22 months to comply with this directive.

SCOPE OF THE DIRECTIVE

As amended, the directive would strive to promote energy efficiency, a circular economy, and decarbonization.
In their provisional agreement, the co-legislators adjusted certain agricultural thresholds for animal rearing: 350 LSU for pigs, 280 LSU for poultry (300 for laying hens) and 380 LSU for mixed farms. Extensive farms and animal farming for domestic use would be excluded from the scope of the directive. The new rules would be applied progressively, starting in 2030 with the largest farms.

The Commission will assess, by 31 December 2026, whether there is a need to further address the emissions from rearing livestock, including from cattle, and a reciprocity clause to ensure producers outside the EU meet requirements similar to EU rules when exporting to the EU.

The agreement also brings mining activities into the scope of the directive, covering the extraction and treatment of non-energy ores produced on an industrial scale, such as iron, copper, gold, nickel and platinum. Subject to a review and legislative proposal by the Commission, the scope may be extended to industrial minerals as well.

Also added is the manufacture of batteries, other than exclusively assembling, in plants with a production capacity of 15,000 tonnes of battery cells (cathode, anode, electrolyte, separator, capsule) or more per year.

EMISSION LIMIT VALUES

The agreement introduces the concept of environmental performance limit values (EPLVs), to be set by the competent authorities in the permit to authorize the establishment and operating of installations. The Council and Parliament agreed to make EPLV ranges binding for all energy resources, except for water, for which competent authorities must set binding targets. EPLVs will be indicative for emerging techniques.

ESTABLISHMENT OF E-PERMITS

The existing directive requires member states to set out binding rules to establish a registration mechanism that enables industrial installations to apply for and obtain a permit, provided that they comply with certain requirements.

The co-legislators agreed to make permitting more efficient and less burdensome by introducing an obligation for member states to establish an electronic permit system (e-permit) by 2035.

In the following you will find a brief description of two BREFs under the IED that are of particular significance for emissions monitoring in Europe:

BEST AVAILABLE TECHNIQUES (BAT) REFERENCE DOCUMENT FOR LARGE COMBUSTION PLANTS

The BAT Reference Document (BREF) for Large Combustion Plants is published by the European Commission pursuant to Article 13(6) of the directive. This BREF for large combustion plants concerns the following activities specified in Annex I to Directive 2010/75/EU:

1. Combustion of fuels in installations with a total rated thermal input of 50 MW or more, only when this activity takes place in combustion plants with a total rated thermal input of 50 MW or more.
2. Gasification of coal or other fuels in installations with a total rated thermal input of 20 MW or more, only when this activity is directly associated with a combustion plant.
3. Disposal or recovery of waste in waste co-incineration plants for non-hazardous waste with a capacity exceeding 3 tonnes per hour or for hazardous waste with a capacity exceeding 10 tonnes per day, only when this activity takes place in combustion plants covered under 1. above.

In particular, this document covers upstream and downstream activities directly associated with the aforementioned activities, including the emission prevention and control techniques applied. The fuels considered in this document are any solid, liquid and/or gaseous combustible material including:

- Solid fuels (e.g. coal, lignite, peat)
- Biomass (as defined in Article 3(31) of Directive 2010/75/EU)
- Liquid fuels (e. g. heavy fuel oil and gas oil)
- Gaseous fuels (e. g. natural gas, hydrogen-containing gas, and syngas)
- Industry-specific fuels (e. g. by-products from the chemical and iron and steel industries)
- Waste except mixed municipal waste as defined in Article 3(39) and except other waste listed in Article 42(2)(a), points (ii) and (iii) of Directive 2010/75/EU

Critical issues for the implementation of Directive 2010/75/EU in the large combustion Plants sector are the emissions to air of nitrogen oxides, sulfur dioxide, hydrogen chloride and fluoride, organic compounds, dust, and metals including mercury; emissions to water resulting especially from the use of wet abatement techniques for the removal of sulfur dioxide from flue gases; resource efficiency and especially energy efficiency. This BREF contains 12 chapters.

DETAILS OF LARGE COMBUSTION PLANTS (LCPS)

- According to IED, a combustion plant in which any fuel is oxidized to produce useful heat (excluding directly fired processes)
- Existing plants permitted before 7 January 2013
- Large combustion plants (Chapter III and Annex V of the IED):
  - > 50 MWth single unit with one stack
  - > 50 MWth multiple units with a common stack (containing one or more flue gas streams)
  - > 50 MWth multiple units with single stacks which could have been flued together in the judgement of the competent authority
- LCP aggregation excludes units < 15 MWth
- Monitoring of air polluting substances must be conducted in accordance with the provisions of Part 3 of IED Annex V. The IED emission limit values to air must be regarded as being complied with if the conditions set out in Part 4 of Annex V are fulfilled
- Emission limit values (ELVs) defined for NOx, SO_2, dust and CO (gas firing only) for different plant technologies & age: fueling, operating hours, during normal operation excluding start-up and shut-down (SU-SD). According to the current IED, ELVs apply for loads >70%
- Permits for LCPs need to be updated in line with the LCP BAT conclusions by August 2021. These BAT conclusions establish performance levels associated with BAT and include monitoring requirements
- Compliance began by 17.08.2021 for existing plants
- BAT-AELs differ enormously with regard to control technologies and monitoring requirements
- IED harmonized reporting for all combustion plants
  - Monthly average: 100%
  - Daily average: 110%
  - Hourly 95 percentile: 200%
- Compliance assessment is based on validated hourly averages (following the subtraction of the confidence interval for each pollutant)
- LCP BREF specifies annual and daily BAT-AELs
- Full ELV compliance subject to derogation, e. g. limited lifetime
- Peripherals are required for correction of reference conditions (O_2 etc.) and flow
- Member States differ in implementation, ongoing IED review

MONITORING REQUIREMENTS LCP BREF

Wide range of pollutants – more aligned with Energy from Waste (EfW) regulation

Group	Species	Applies to	Frequency	Unless	Then
1. IED pollutants	NO_x	All fuels	Continuous	Plant <100 MWth and <1,500 h/yr operation	Periodic (6 m)
	CO				
	SO_2	Coal, bio-mass, HFO, gas oil			
		Oil fired without SO_2 abatement			Periodic (3 m)
	Dust	Coal, bio-mass, HFO, gas oil	Continuous	Plant <100 MWth and <1,500 h/yr operation	Periodic (6 m)
2. Acid gases	HCI	Coal	Periodic (3 m)	Emissions are 'sufficiently stable'	Periodic (12 m)
				Plant < 100 MWth and < 1,500 h/yr operation	Periodic (6 m)
		Biomass	Continuous	Emissions are 'sufficiently stable'	Periodic (6 m)
				Plant < 100 MWth and < 1,500 h/yr operation	Periodic (6 m)
				Plant < 100 MWth and < 500 h/yr operation	Periodic (12 m)
	HF	Coal	Periodic (3 m)	Emissions are 'sufficiently stable'	Periodic (12 m)
				Plant < 100 MWth and < 1,500 h/yr operation	Periodic (6 m)
		Biomass	Periodic (12 m)		
3. Metals	Hg	Coal (≥ 300 MWth)	Continuous	Emissions are 'sufficiently stable'	Periodic (6 m)
		Biomass	Periodic (12 m)	Emissions are 'sufficiently stable'	No monitoring
	Trace metals	Coal, bio-mass, HFO, gas oil	Periodic (12 m)	Emissions are deemed insignificant	Less frequent
4. Abatement	NH_3	All fuels with SCR/SNCR	Continuous	Plant < 100 MWth and < 1,500 h/yr operation	Periodic (6 m)
				Emissions are 'sufficiently stable' (SCR only)	Periodic (12 m)
	SO_3	All fuels with SCR	Periodic (12 m)	–	–

BEST AVAILABLE TECHNIQUES (BAT) REFERENCE DOCUMENT FOR WASTE INCINERATION

The Best Available Techniques (BAT) Reference Document (BREF) for Waste Incineration is also published by the European Commission pursuant to Article 13(6) of the directive. The BREF for waste incineration covers

- The disposal or recovery of waste in waste incineration plants and waste co-incineration plants, and
- The disposal or recovery of waste involving the treatment of slags and/or bottom ashes from the incineration of waste

Critical issues for the implementation of Directive 2010/75/EU in the waste incineration (WI) sector include emissions to air, emissions to water, and the efficiency of the recovery of energy and of materials from the waste. This BREF contains 7 chapters, which include

- General information on the WI sector
- Information on the common processes and general techniques for the pre-treatment, storage, and handling of different types of waste, thermal treatment, energy recovery, flue gas cleaning, waste water treatment and the treatment of solid residues
- Currently reported ranges of the emission and consumption levels
- Techniques to consider in the determination of BAT
- BAT conclusions as defined in Article 3(12) of the directive
- Information on 'emerging techniques' as defined in Article 3(14) of the directive, as well as recommendations for future work

WI BREF 2019

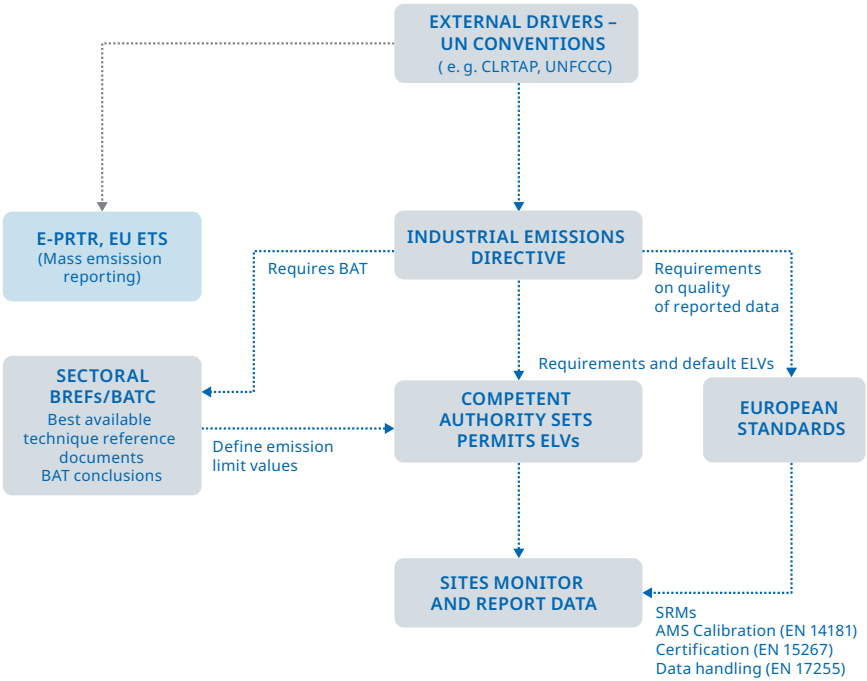
- WI BREF and BATC documents published in December 2019, coming into effect in December 2023
- Scope: > 3 t/h non hazardous waste or > 10 t/d hazardous waste
- ELV ranges

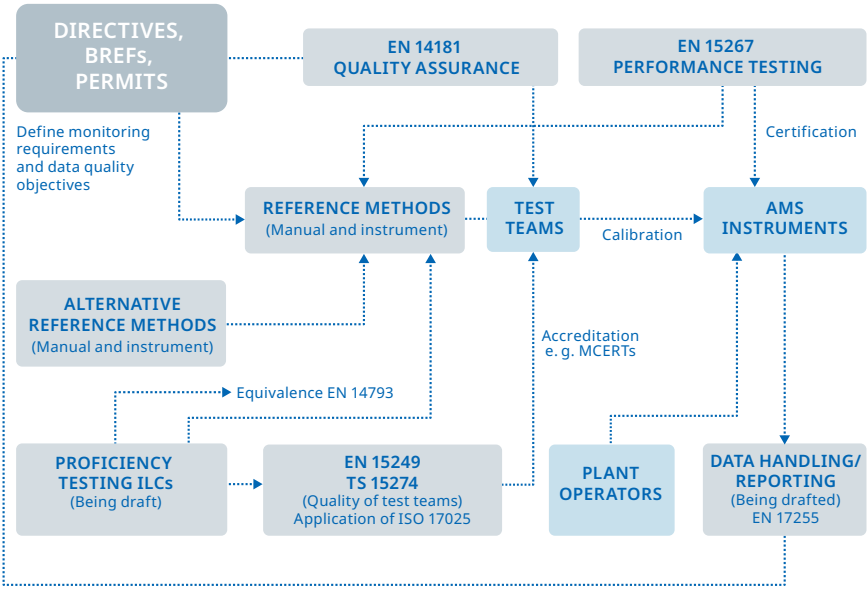
mg/m³*	HF	HCI	SO_2	NH_3	NO_X	CO	TVOC	Hg	Dust
WI BREF 2006 daily average, maximum	1	8	40	10	100	30	10		5
WI BREF 2006 daily average new plant, maximum	1	6	30	10	120	50	10	20	5
WI BREF 2006 daily average existing plant, maximum	1	8	40	10	150	50	10	20	5

** Measure is displayed at 1,013.25 hPa and 0 °C*

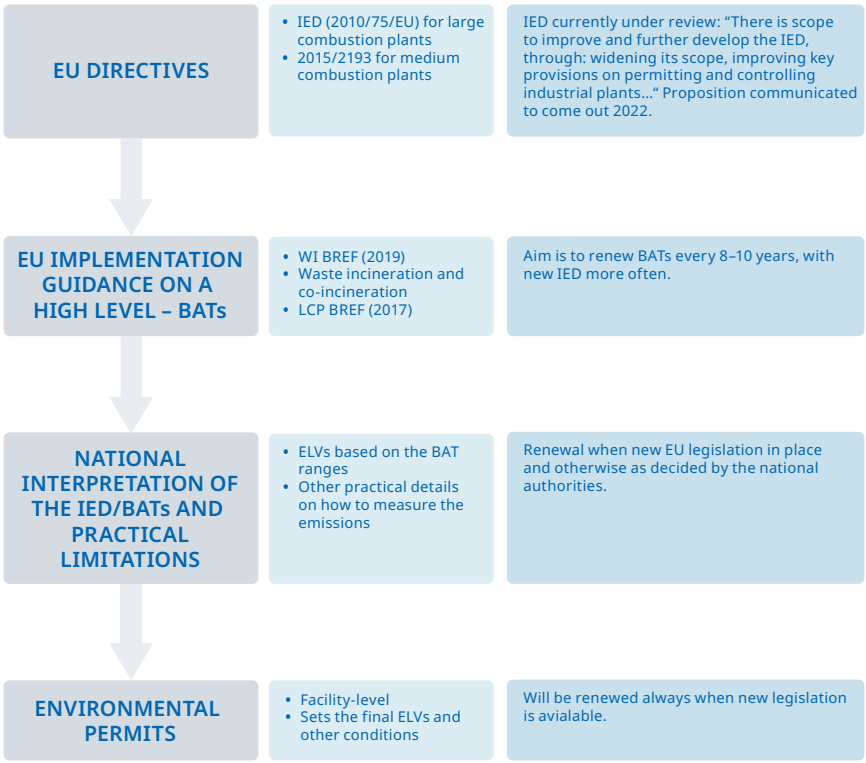
- All environmental permits for existing waste incineration installations in Europe need to be reviewed during the implementation period of 4 years
- The most notable change is the requirement to monitor mercury emissions

The following figure illustrates the interdependencies and relationships within the emissions monitoring framework under the IED, while the figure on page 19 explains the structure of main quality assurance standards under associated directives and BREFs. Emission monitoring quality assurance is covered by EN 14181 with EN 15267 parts 1–4 describing type testing of emission monitoring and measuring equipment.




DIRECTIVES, BREFs, PERMITS
EN 14181 QUALITY ASSURANCE
EN 15267 PERFORMANCE TESTING
Define monitoring requirements and data quality objectives
Certification
REFERENCE METHODS (Manual and instrument)
TEST TEAMS
Calibration
AMS INSTRUMENTS
ALTERNATIVE REFERENCE METHODS (Manual and instrument)
Accreditation e. g. MCERTs
Equivalence EN 14793
PROFICIENCY TESTING ILCs (Being draft)
EN 15249 TS 15274 (Quality of test teams) Application of ISO 17025
PLANT OPERATORS
DATA HANDLING/ REPORTING (Being drafted) EN 17255

The following figure summarizes the hierarchy of major directives and regulations under the IED from EU to national levels.



THE MEDIUM COMBUSTION PLANT DIRECTIVE

There are estimated to be around 143,000 medium combustion plants (MCPs) in the EU, which are an important source of emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_X) and dust.

Directive (EU) 2015/2193 on the limitation of emissions of certain pollutants into the air from MCPs, known as the Medium Combustion Plant Directive, regulates pollutant emissions from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt thermal (MWth) and less than 50 MWth.
The MCPD also implements obligations arising from the Gothenburg Protocol under the UNECE Convention on Long-Range Transboundary Air Pollution.
This directive fills the regulatory gap at EU level between large combustion plants (> 50 MWth), covered by the Industrial Emissions Directive (IED) and smaller appliances (heaters and boilers < 1 MWth) covered by the Ecodesign Directive.

The MCPD regulates emissions of SO_2, NO_X and dust to air and also requires monitoring of carbon monoxide (CO) emissions. The emission limit values set in the MCPD apply from 20 December 2018 for new plants and 2025 or 2030 for existing plants, depending on their size.

Periodic measurements must be required at least:

- Every three years for MCPs 1–20 MW
- Every year for MCPs >20 MW
- Measurements must be required only for: (a) pollutants for which an emission limit value is laid down in this directive for the plant concerned with measurements (b) for CO for all plants
- Portable AMS must comply with the latest version of EN 15267-4. It must constitute an equivalent method to a SRM accepted

1 | THE EUROPEAN DIRECTIVES – TABLES

THE EUROPEAN DIRECTIVES – TABLES

EMISSION LIMIT VALUES FOR WASTE INCINERATION PLANTS (CONTINUOUS MEASUREMENTS, STANDARDIZED AT 11% O_2, MINERAL WASTE OIL AT 3% O_2), SHOWN IN MG/M³

	Specials	Daily avg. WID 2000	1/2 h avg. WID 2000 (100%) <1/2 h-LV A	1/2 h avg. WID 2000 (97%) <1/2 h-LV B	Daily avg. IED 2010	1/2 h avg. WID 2000 (100%) <1/2 h-LV A	1/2 h avg. WID 2000 (97%) <1/2 h-LV B
Dust		10	30	10	10	30	10
TOC		10	20	10	10	20	10
HCl		10	60	10	10	60	10
HF		1	4	2	1	4	2
SO_2		50	200	50	50	200	50
NO_2	≤6 t/d existing plants [1]	200	Not included		400	Not included	
	>6 t/d existing and all new plants	200	400	200	200	400	200
CO		50	100 [2]	150 (95% at 10 min) [2]	50 (97%)	100 [2]	150 (95% at 10 min) [2]

Remarks:

1) Existing plant full requested for authorization before 28 December 2002 and put into operation not later than 28 December 2004

2) Alternatively

- Emission limit values according to WID up to 40% thermal co-incineration
- Limit value calculation for solid, liquid and biological waste according to the following formula, if no specific limit value has been defined
- If waste incineration is the main purpose of a co-incineration plant, it must be treated as a normal incineration plant. If the heat release from the waste incineration is less than 10% of the total heat release, it is set to equal 10%.

$$C = \frac{C_{PROC} * V_{PROC} + C_{WASTE} * V_{WASTE}}{V_{PROC} + V_{WASTE}}$$

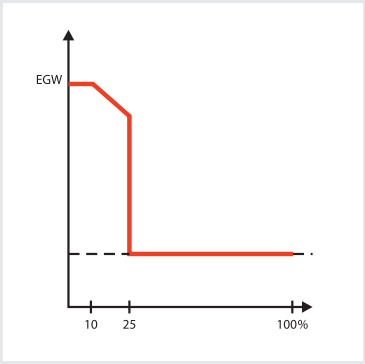
V_{WASTE}
Waste gas volume resulting from the incineration of waste only determined from the waste with the lowest calorific value specified in the permit and standardized at the conditions given by this Directive.

V_{PROC}
Waste gas volume resulting from the plant process including the combustion of the authorised fuels normally used in the plant (wastes excluded).

C_{WASTE}
Emission limit values for waste incineration plants.

C_{PROC}
Emission limit values for certain industrial activities or in case of the absence of such values, emission limit values of plants which comply with the national laws, regulations and administrative provisions for such plants while burning the normally authorised fuels (wastes excluded).

C
Total emission limit values for certain industrial activities and certain polluting substances.



C_{Proc} FOR COMBUSTION PLANTS CO-INCINERATING WASTE

Pollutant	Plant specification		EC Directive 2000/76 Waste incineration	EC Directive 2010/75 Industrial emissions		
	Fuel	Thermal input [MW]	C_{Proc} as daily avg. [mg/m³]	C_{Proc} as daily avg. [mg/m³] transitional ruling [1]	C_{Proc} as daily avg. [mg/m³] existing plants as of 01.01.2016 [2]	C_{Proc} as daily avg. [mg/m³] new plants as of 07.01.2013 [3]
Dust	Solid fuels with the exception of biomass (O_2 content 6%)	<50	50	50	50	50
		50 ... 100	50	50	30	20
		100 ... 300	30	30	25 (peat: 20)	20
		>300	30	30	20	10 (peat: 20)
	Biomass (O_2 content 6%)	<50	50	50	50	50
		50 ... 100	50	50	30	20
		100 ... 300	30	30	20	20
		>300	30	30	20	20
	Liquid fuels (O_2 content 3%)	<50	50	50	50	50
		50 ... 100	50	50	30	20
		100 ... 300	30	30	25	20
		>300	30	30	20	10

C_{Proc} for combustion plants co-incinerating waste

Pollutant	Plant specification		EC Directive 2000/76 Waste incineration	EC Directive 2010/75 Industrial emissions		
	Fuel	Thermal input [MW]	C_{Proc} as daily avg. [mg/m³]	C_{Proc} as daily avg. [mg/m³] transitional ruling [1]	C_{Proc} as daily avg. [mg/m³] existing plants as of 01.01.2016 [2]	C_{Proc} as daily avg. [mg/m³] new plants as of 07.01.2013 [3]
SO_2	Solid fuels with the exception of biomass (O_2 content 6%)	<50	Not included	Not included	Not included	Not included
		50 … 100	850 (SAG≥90%) [4]	850	400 (peat: 300)	400 (peat: 300)
		100 … 300	850 to 200 (linear decrease) (SAG≥92%) [4]	200	200	200 (peat: 300, peat with fluidized bed 250)
		>300	200 (SAG≥95%) [4]	200	200	150 (fluidized bed partial 200)
	Biomass (O_2 content 6%)	<50	Not included	Not included	Not included	Not included
		50 … 100	200	200	200	200
		100 … 300	200	200	200	200
		>300	200	200	200	150
	Liquid fuels (O_2 content 3%)	<50	Not included	Not included	Not included	Not included
		50 … 100	850	850	350	350
		100 … 300	850 to 200 (linear)	400 to 200 (linear)	250	200
		>300	200	200	200	150

Continued on next page

C_{Proc} for combustion plants co-incinerating waste

Pollutant	Plant specification		EC Directive 2000/76 Waste incineration	EC Directive 2010/75 Industrial emissions		
	Fuel	Thermal input [MW]	C_{Proc} as daily avg. [mg/m³]	C_{Proc} as daily avg. [mg/m³] transitional ruling [1]	C_{Proc} as daily avg. [mg/m³] existing plants as of 01.01.2016 [2]	C_{Proc} as daily avg. [mg/m³] new plants as of 07.01.2013 [3]
NO_2	Solid fuels with the exception of biomass (O_2 content 6%)	<50	Not included	Not included	Not included	Not included
		50 ... 100	400	400	300 (lignite: 400)	300 (peat: 250)
		100 ... 300	300	200	200	200
		>300	200	200	200	150 (pulv. lignite: 200)
	Biomass (O_2 content 6%)	<50	Not included	Not included	Not included	Not included
		50 ... 100	350	350	300	250
		100 ... 300	300	300	250	200
		>300	300	200	200	150
	Liquid fuels (O_2 content 3%)	<50	Not included	Not included	Not included	Not included
		50 ... 100	400	400	400	300
		100 ... 300	300	200	200	150
		>300	200	200	150	100

Remarks:

1) *For existing plants before 31 December 2015 and new plants before 7 January 2013 (new/existing plant definition see IED Article 30, paragraphs 2 and 3)*
2) *For existing plants as of 1 January 2016 (new/existing plant definition see IED Article 30, paragraphs 2 and 3)*
3) *For new plants as of 7 January 2013 (new/existing plant definition see IED Article 30, paragraphs 2 and 3)*
4) *With indigenous fuels alternatively minimum rates of desulfurization (=SAG)*

SPECIAL CEMENT PLANT REGULATION

Pollutant	Daily limit value
Dust	30
NO_x (existing plants)	800
NO_x (new plants)	500
HCl	10
HF	1
TOC	10
SO_2	50
CO	To be defined locally

All values are in mg/m^3 at 10% O_2

LCPD – DIRECTIVE 2001/80/EC ON THE LIMITATION OF EMISSIONS OF CERTAIN POLLUTANTS INTO THE AIR FROM LARGE COMBUSTION PLANTS

The LCPD covered all combustion installations with a rated thermal output exceeding 50 MW irrespective the type of fuel used with the exception of waste. The directive applies only to combustion plants designed for production of energy with the exception of those which make direct use of the products of combustion in manufacturing processes.

Existing plants
Licensed before 1 July 1987 will have to comply with the emission limit values in Annex A of the Directive at the latest on 1 January 2008 (exception: no more than 20,000 operational hours after 1 January 2008 ending no later than 31 December 2015).

New plants
Licensed after 1 July 1987 but before 27 November 2002, in operation 27 November 2003 at the latest will have to comply with the emission limit values in Annex A of the Directive.

New new plants
Licensed after 27 November 2002 or in operation later than 27 November 2003 will have to comply with the limit values of part B of the Directive. National, more stringent time and emission limit values possible.

LCPD 2001/80/EC requirements
Emission standards must be regarded as having been complied with, if within one calendar year.

Existing plants, starting 1 January 2008, new plants until 2002/2003:
- None of the calendar monthly mean values exceeds the emission values A
- 97% of all 48 hourly SO_2 and dust mean values do not exceed 110% of emission limit values A
- 95% of all 48 hourly NO_x mean values do not exceed 110% of emission values A

New plants, later than 2002/2003
- No validated daily average value exceeds the relevant limit values B
- 95% of all the validated hourly averages values do not exceed 200% of the relevant limit values B
- Continuous measurement for SO_2, NO_x and dust required for plants > 100 MW

IED 2010/75/EU requirements for combustion plants
Directive 2010/75/EC on Industrial Emissions (IED) replaced the LCPD 2001/80/EC with effect from 1 January 2016.

Existing plants
Permitted before 7 January 2013 and put into operation not later than 7 January 2014.

New plants
Permitted after 7 January 2013 or in operation later than 7 January 2014.

Emission standards must be regarded as having been complied with if the evaluation of the measurement results indicates, for operating hours within a calendar year, that all of the following conditions have been met:

- No validated monthly average value exceeds the relevant emission limit values set out in the tables below
- No validated daily average value exceeds 110% of the relevant emission limit values set out in the tables below
- 95% of all the validated hourly average values over the year do not exceed 200% of the relevant emission limit values set out in the tables below

EMISSION LIMIT VALUES (MG/M³*) FOR COMBUSTION PLANTS USING SOLID FUELS WITH THE EXCEPTION OF GAS TURBINES AND GAS ENGINES, STANDARDIZED AT 6% O_2

	Thermal input and fuel LCPD 2001		Limit values LCPD 2001 existing plants [1])	Limit values LCPD 2001 new plants [2])	Thermal input and fuel IED 2010		Limit values IED existing plants [3])	Limit values IED new plants [4])
SO_2	<50 MW		Not included		25 ... 50 MW		In preparation	
	50 ... 100 MW	In general	2000	850	50 ... 100 MW	In general	400	400
		Biomass	2000	200		Biomass	200	200
						Peat	300	300
	100 ... 500 MW		2,000 to 400 linear decrease	200	100 ... 300 MW	In general	250	200
						Biomass	200	200
						Peat	300	300
	>500 MW		400	200	>300 MW	In general	200	150
						Fluidized bed	200	200
NO_2	<50 MW		Not included		25 ... 50 MW		In preparation	
	50 ... 100 MW		600	400	50 ... 100 MW	In general	300	300
						Lignite	450	400
						Biomass, peat	300	250
	100 ... 300 MW	In general	600	200	100 ... 300 MW	In general	200	200
		Biomass		300		Biomass, peat	250	200
	300 ... 500 MW		600	200				
	>500 MW	Before 2015	500	200	>300 MW	In general	200	150
		After 2016	200			Lignite	200	200

** Measure is displayed at 1,013.25 hPa and 0 °C*

Emission limit values (mg/m³*) for combustion plants using solid fuels with the exception of gas turbines and gas engines, standardized at 6% O_2

	Thermal input and fuel LCPD 2001	Limit values LCPD 2001 existing plants [1]	Limit values LCPD 2001 new plants [2]	Thermal input and fuel IED 2010		Limit values IED existing plants [3]	Limit values IED new plants [4]
Dust	<50 MW	Not included		25 … 50 MW		In preparation	
	50 … 100 MW	100	50	50 … 100 MW		30	20
	100 … 500 MW	100	30	100 … 300 MW	In general	25	20
					Biomass, peat	20	
	>500 MW	50	30	>300 MW	In general	20	10
					Biomass, peat	20	20

Remarks:

1) *New and existing plants according to LCPD, Article 4, paragraph 1 or 3*
2) *New plants according to LCPD, Article 4, paragraph 2*
3) *Existing plants according to IED, Article 30, paragraph 2: permitted before 7 January 2013 and put into operation no later than 7 January 2014 (derogations up to 2016)*
4) *New plants according to IED, Article 30, paragraph 3: all plants except paragraph 2*

EMISSION LIMIT VALUES (MG/M³*) FOR COMBUSTION PLANTS USING LIQUID FUELS WITH THE EXCEPTION OF GAS TURBINES AND GAS ENGINES, STANDARDIZED AT 3% O_2

	Thermal input and fuel LCPD 2001		Limit values LCPD 2001 existing plants [1])	Limit values LCPD 2001 new plants [2])	Thermal input and fuel IED 2010		Limit values IED existing plants [3])	Limit values IED new plants [4])
SO_2	<50 MW		Not included		25 ... 50 MW		In preparation	
	50 ... 100 MW		1,700	850	50 ... 100 MW		350	350
	100 ... 300 MW		1,700	400 to 200 linear decrease	100 ... 300 MW		250	200
	300 ... 500 MW		1,700 to 400 linear decrease	200				
	>500 MW		400	200	>300 MW		200	150
	<50 MW		Not included		25 ... 50 MW		In preparation	
NO_2	50 ... 100 MW		450	400	50 ... 100 MW		450	300
	100 ... 300 MW	In general	450	200	100 ... 300 MW	In general	200	150
		Biomass		300		Refineries	450	
					300 ... 500 MW	Others	150	100
	300 ... 500 MW		450	200		Refineries	450	
	>500 MW		400	200	>500 MW		150	100
	<50 MW		Not included		25 ... 50 MW		In preparation	

** Measure is displayed at 1,013.25 hPa and 0 °C*

Emission limit values (mg/m³*) for combustion plants using liquid fuels with the exception of gas turbines and gas engines, standardized at 3% O_2

	Thermal input and fuel LCPD 2001	Limit values LCPD 2001 existing plants [1]	Limit values LCPD 2001 new plants [2]	Thermal input and fuel IED 2010		Limit values IED existing plants [3]	Limit values IED new plants [4]
Dust	50 ... 100 MW	50	50	50 ... 100 MW	In general	30	20
					Refineries	50	
	100 ... 500 MW	50	30	100 ... 300 MW	In general	25	20
					Refineries	50	
	>500 MW	50	30	>300 MW	In general	20	10
					Refineries	50	

Remarks:

1) *New and existing plants according to LCPD, Article 4, paragraph 1 or 3*
2) *New plants according to LCPD, Article 4, paragraph 2*
3) *Existing plants according to IED, Article 30, paragraph 2: permitted before 7 January 2013 and put into operation not later than 7 January 2014 (derogations up to 2016)*
4) *New plants according to IED, Article 30, paragraph 3: all plants except paragraph 2*

EMISSION LIMIT VALUES (MG/M³*) FOR COMBUSTION PLANTS USING GASEOUS FUELS WITH THE EXCEPTION OF GAS TURBINES AND GAS ENGINES, STANDARDIZED AT 3% O_2

	Thermal input and fuel LCPD 2001		Limit values LCPD 2001 existing plants [1]	Limit values LCPD 2001 new plants [2]	Thermal input and fuel IED 2010		Limit values IED existing plants [3]	Limit values IED new plants [4]
SO_2	<50 MW		Not included		25 ... 50 MW		In preparation	
	>50 MW	In general	35		>50 MW	In general	35	
		Liquefied gas	5			Liquefied gas	5	
		Coke oven gas	800	400		Coke oven gas	400	
		Blast furnace gas	800	200		Blast furnace gas	200	
		Gases from the gasification of refinery residues	800					
	<50 MW		Not included		25 ... 50 MW		In preparation	

** Measure is displayed at 1,013.25 hPa and 0 °C*

Emission limit values (mg/m³*) for combustion plants using gaseous fuels with the exception of gas turbines and gas engines, standardized at 3% O_2

	Thermal input and fuel LCPD 2001		Limit values LCPD 2001 existing plants [1]	Limit values LCPD 2001 new plants [2]	Thermal input and fuel IED 2010		Limit values IED existing plants [3]	Limit values IED new plants [4]
NO_2	50 … 100 MW	Natural gas	Not specified	150	50 … 100 MW	Natural gas	100	100
		In general	300	200		Steel industry gas	200	
						Refineries	200	
	100 … 300 MW	Natural gas	Not specified	150	100 … 300 MW	Natural gas	100	100
		In general	300	200		Steel industry gas	200	
	300 … 500 MW	Natural gas	Not specified	150		Refineries	200	
		In general	300	200				
	>500 MW	Natural gas	Not specified	100	>300 MW	Natural gas	100	100
		In general	200	200		Steel industry gas	200	
						Refineries	200	
	<50 MW		Not included		25 … 50 MW		In preparation	
Dust	>50 MW	In general	5	5	>50 MW	In general	5	
		Blast furnace gas	10	10		Blast furnace gas	10	
		Steel industry gas	50	30		Steel industry gas	30	
CO	>50 MW	No defaults			>50 MW	Natural gas	100	

Remarks:

1) *New and existing plants according to LCPD, Article 4, paragraph 1 or 3*
2) *New plants according to LCPD, Article 4, paragraph 2*
3) *Existing plants according to IED, Article 30, paragraph 2: permitted before 7 January 2013 and put into operation not later than 7 January 2014 (derogations up to 2016)*
4) *New plants according to IED, Article 30, paragraph 3: all plants except paragraph 2*

EMISSION LIMIT VALUES (MG/M³*) FOR COMBUSTION PLANTS OF GAS TURBINES AND GAS ENGINES STANDARDIZED AT 15% O_2

	Thermal input and fuel LCPD 2001		Limit values LCPD 2001 existing plants [1])	Limit values LCPD 2001 new plants [2])	Thermal input and fuel IED 2010		Limit values IED existing plants [3])	Limit values IED new plants [4])
SO_2	<50 MW		Not included		25 ... 50 MW		In preparation	
	50 ... 100 MW		Not included		50 ... 100 MW		Not included	
NO_2	<50 MW		Not included		25 ... 50 MW		In preparation	
	>50 MW	Gas turbines, liquid fuels (light and medium distillate)		120	>50 MW	Liquid fuels (light and medium distillate)	90	50
		Gas turbines, natural gas		50		Natural gas	50	50
		Gas turbines, other gaseous fuels		120		Other gaseous fuels	120	50
						Gas engine	120	75

** Measure is displayed at 1,013.25 hPa and 0 °C*

Emission limit values (mg/m³*) for combustion plants of gas turbines and gas engines standardized at 15% O_2

	Thermal input and fuel LCPD 2001		Limit values LCPD 2001 existing plants [1]	Limit values LCPD 2001 new plants [2]	Thermal input and fuel IED 2010		Limit values IED existing plants [3]	Limit values IED new plants [4]
Dust	<50 MW		Not included		25 ... 50 MW		In preparation	
	>50 MW		Not included		50 ... 100 MW			
CO	> 50 MW	No defaults			>50 MW	Gas turbines, liquid fuels (light and medium distillate)	100	
						Gas turbines, natural gas	100	
						Gas engine	100	

Remarks:

1) *New and existing plants according to LCPD, Article 4, paragraph 1 or 3*
2) *New plants according to LCPD, Article 4, paragraph 2*
3) *Existing plants according to IED, Article 30, paragraph 2: permitted before 7 January 2013 and put into operation not later than 7 January 2014 (derogations up to 2016)*
4) *New plants according to IED, Article 30, paragraph 3: all plants except paragraph 2*

2 | EN 14181

EN 14181

The stated European directives stipulate in the annexes on measurement technology that sampling and analysis of all pollutants is to be carried out in accordance with CEN standards. The associated CEN standard was compiled by the technical committee CEN/TC 264 “Air Quality”. The European standard EN 14181 specifies procedures for establishing quality assurance levels (QAL) for automated measuring systems (AMS) installed on industrial plants for the determination of the flue gas components and other flue gas parameters. It was approved by CEN on 3 November 2003 and officially released in July 2004; it has been updated by 30 November 2014. Appendix J of EN 14181: 2014 describes the main technical changes between the first and second edition of the standard.

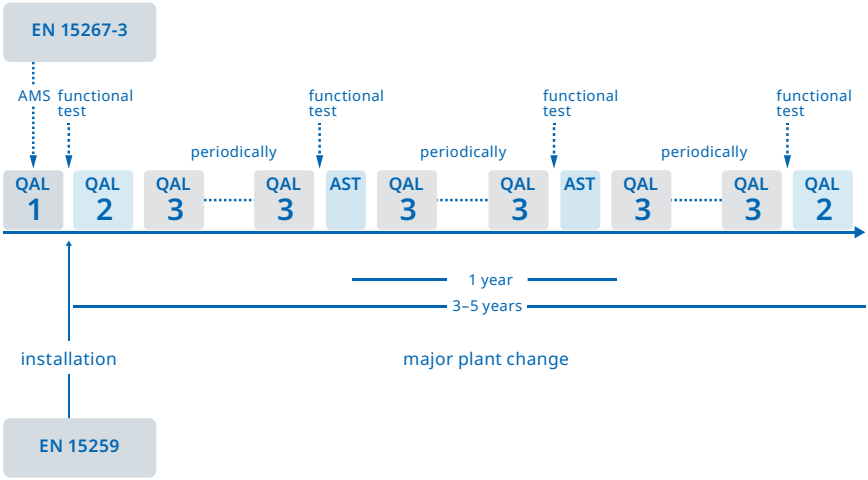
Besides the three quality assurance levels an annual surveillance test (AST) for automated measuring systems is defined in EN 14181.

QAL1 – First quality assurance level
Requirement for use of automatic measuring systems that have been proven suitable for its measurement task. The suitability test is specified in EN 15267-1, EN 15267-2, EN 15267-3 and EN ISO 14956.

QAL2 – Second quality assurance level
Procedure to calibrate the AMS and determine the variability of the measured values obtained by it, so as to demonstrate the suitability of the AMS for its application, following its installation.

QAL3 – Third quality assurance level
Continuous quality assurance by the operator during normal operation of an AMS (drift and precision of the AMS, verification on control card).

AST – Annual surveillance test
Annual surveillance test to evaluate that the AMS functions correctly and its performance remains valid and that its calibration function and variability remain as previously determined.



EN 14181 stipulates which characteristics AMS automated measuring systems must possess, and how they must be calibrated and maintained. In addition to the calibration function, the measuring uncertainty – which plays a decisive role in the validation of the measured values obtained during continuous monitoring – is also determined from the calibration data. In addition, the requirements for the uncertainty of the measured values obtained with the measuring equipment, which are defined in the EU directives relating to fossil power plants, waste incineration plants and waste co-incineration plants, are checked using a method described in the standard.

All new installed automated measuring systems must be certified in accordance with the standards EN 15267-1, EN 15267-2 and EN 15267-3. The AMS must be able to measure in a range of zero and a value of 1.5 times the emission limit value (ELV) for waste incineration plants. For large combustion plants, it must be able to measure in a range of zero and a value of 2.5 times the ELV.

EN 14181 – QUALITY ASSURANCE OF AUTOMATED MEASURING SYSTEMS

Influenced by:
- VDI 2066/3950
- ISO 10155
- North American (RATA) requirements

Prerequisites:
- Suitable measuring systems
- Comparable measuring systems
- Correct installation
- Permanent quality assurance during plant operation

QAL1 – Suitability test
QAL1 specifies the suitability of a measuring instrument by calculating the total measuring uncertainty in accordance with EN ISO 14956 prior to installation. During the suitability test, it must be proven that the total uncertainty obtained from the AMS meets the specification for uncertainty stated in the applicable regulations. The suitability test is a combination of laboratory and field testing.

During the laboratory test the following performance characteristics are determined:
- Influence of ambient temperature, voltage and vibrations
- Linearity
- Response time

During the field test the following performance characteristics are determined:
- Drift
- Response time
- Availability
- Maintenance interval
- Reproducibility
- Calibration capability

QAL1 VALUES OF SELECTED DURAG GROUP DEVICES

Device		QAL1 Total expanded uncertainty $U=u_c \cdot 1.96$	QAL2 Total allowed uncertainty percentage of daily limit value	Availability (minimum requirement: >95%, for O_2: >98%)
D-R 290		0.52 mg/m³	30	99.4%
D-R 320		0.35 mg/m³	30	97.5%
D-R 808		0.30 mg/m³	30	99.3%
D-R 909		0.66 mg/m³	30	99.7%
ProCeas LaserCEM	CO	3.12 mg/m³	10	98.5%
	CO (L)	1.45 mg/m³	10	
	H_2O	1.57% vol	10	
	HCl	0.66 mg/m³	40	
	NH_3	0.75 mg/m³	40	
	HF	0.09 mg/m³	40	
	NO	3.83 mg/m³	20	
	NO_2	1.87 mg/m³	20	
	O_2	0.61% vol	10	
	SO_2	3.71 mg/m³	20	
	CH_4	0.23 mg/m³	30	

QAL2 – Calibration and validation of the AMS

- Functional test of the AMS including check for correct installation
- Correct selection of the measuring range
- Calibration of the device using a standard reference method (SRM)
- Determination of the calibration function of the AMS and its range of validity
- Calibration function either as linear regression or straight line from the zero point to the center of a point cluster
- Calculation of the fluctuation range at the 95 % confidence interval
- Test repeated at least every 5 years and more frequently if required by legislation or authority

QAL3 – Continuous monitoring

- Permanent quality assurance during plant operation through the operating personnel
- Assurance of reliable and correct operation of the measuring system (maintenance records)
- Regular checks, at least once per maintenance interval
- Zero point, measuring range, drift
- Determination of drift and accuracy using CUSUM cards or with an Excel chart
- Identification/definition of when manufacturer's maintenance is necessary for the measuring instrument

AST – Annual surveillance test

- Annual confirmation of the QAL2 calibration curve
- Verification of the validity of the calibration curve
- Function test
- Small calibration using 5 parallel measurements
- QAL2 is to be repeated if AST fails
- Resetting of the exceedance counter for the invalid calibration range

3 | EN 15267

EN 15267

Tested and certified equipment for continuous emission and ambient air monitoring is the basis of optimal pollution control. An AMS automated measuring system must comply with performance criteria, maximum permissible measurement uncertainties and testing requirements. The European standard EN 15267 specifies the general principles, including procedures and requirements, for the product certification of AMS for monitoring ambient air quality and emissions from stationary sources. It comprises four parts:

Part 1: General principles

Part 2: Initial assessment of the manufacturer's quality management system and post certification surveillance for the manufacturing process

Part 3: Performance criteria and test procedures for stationary automated measuring systems for continuous monitoring of emissions from stationary sources

Part 4: Performance criteria and test procedures for portable automated measuring systems for periodic measurements of emis sions from stationary sources

The product certification consists of the following sequential stages:

- Performance testing of an AMS
- Initial assessment of the manufacturer's quality management system
- Certification
- Surveillance

Performance testing consists of laboratory and field testing. Field testing is carried out for at least three months on an industrial installation representative of the intended application. All tests are carried out by an accredited testing laboratory.

The test report of the performance testing will be evaluated in the context of a technical examination moderated by the German Environment Agency. If the outcome is positive, a certificate is issued by the German Environment Agency for a period of five years and published in the Federal Gazette and on the website www.qal1.de.
The manufacturer's quality management system and production must undergo an initial audit and recurring annual audits in addition to the standard EN ISO 9001 audit.

During the annual audits, any necessary changes to the hardware and/or software used in the measuring systems are reviewed and confirmed by further investigation if necessary. The manufacturer must record all modifications in a technical logbook. The modifications are divided into the following categories:

Type 0: No measurable influence on the measuring system

Type 1: No significant influence

Type 2: Significant influence, a partial or total review by the test institute may be necessary

MINIMUM REQUIREMENTS FOR AUTOMATED MEASURING SYSTEMS IN THE LABORATORY TEST (L) AND FIELD TEST (F)

Performance characteristic	Minimum requirement				
	Dust	Gases except O_2	O_2	Volume flow	Laboratory field test
Response time	≤200 s	≤200 s ≤400 s for NH_3, HCl, Hg and HF	≤200 s	≤60 s	L + F
Repeatability standard deviation at zero point	≤2.0% a)	≤2.0% a)	≤0.20% b)	–	L
Repeatability standard deviation at span point	≤5.0% c)	≤2.0% a)	≤0.20% b)	≤ 2.0 % lower reference point; ≤ 2.0 % upper reference point	L
Lack-of-fit	≤3.0% a)	≤2.0% a)	≤ 0.20% b)	≤3.0%	L + F
Influence of ambient temperature change from nominal value at 20 °C within specified range at zero point	≤5.0% a)	≤5.0% a)	≤ 0.50% b)	–	L
Influence of ambient temperature change from nominal value at 20 °C within specified range at span point	≤5.0% a)	≤5.0% a)	≤0.50% b)	≤5.0% lower reference point; ≤ 5,0% upper reference point	L
Influence of sample gas pressure at span point, for a pressure change Δp of 3 kPa	–	≤2.0% a)	≤0.20% b)	–	L
Influence of sample gas flow on extractive AMS for a given specification by the manufacturer	–	≤2.0% a)	≤0.20% b)	–	L
Influence of voltage, at –15% below and at +10% above nominal supply voltage	≤2.0% a)	≤2.0% a)	≤0.20% b)	≤2.0% a)	L

Minimum requirements for automated measuring systems in the laboratory test (L) and field test (F)

Performance characteristic	Minimum requirement				
	Dust	Gases except O_2	O_2	Volume flow	Laboratory field test
Influence of vibration	≤2.0% a)	≤2.0% a)	≤0.20% b)	–	L
Cross-sensitivity	–	≤4.0% a)	≤0.40% b)	–	L
Excursion of the measurement beam of in-situ AMS	–	≤2.0% a)	–	–	L
Converter efficiency for AMS for measuring NO_x	–	≥0.95%	–	–	L
Converter efficiency for AMS for measuring Hg	–	≥0.90%	–	–	L
Assessment of the QAL3 control capability	–	–	–	Verified	L
Assessment of the linearity control capability	–	–	–	Verified d)	L
Determination coefficient of calibration function, R^2	≥0.80	≥0.85	≥0.85	≥0.90	F
Minimum maintenance interval	8 days	8 days	8 days	≥8 Tage	F
Zero drift within maintenance interval	≤3.0% a)	≤3.0% a)	≤0.20% b)	–	F
Span drift within maintenance interval	≤3.0% a)	≤3.0% a)	≤0.20% b)	≤ 2.0 % lower reference point; ≤ 4.0 % upper reference point	F
Availability	≥95.0 %	≥95.0%	≥98.0% b)	≥95.0%	F
Reproducibility, R_f	≤2,0% a) (>20 mg/m³) ≤3,3% a) (≤20 mg/m³)	≤3.3% a)	≤0.20% b)	≤3.3%	F

Remarks:

a) Percentage value as percentage of the upper limit of the certification range

b) Percentage value as oxygen volume concentration (volume fraction)

c) Percentage value as percentage of the emission limit value

d) The manufacturer must describe the linearity test capability of the AMS as part of the functional test and the test laboratory must evaluate it

4 | EMISSION DATA EVALUATION + ASSESSMENT

EMISSION DATA EVALUATION + ASSESSMENT

The evaluation of the continuously acquired emission values must comply with the relevant legal requirements, fulfill the requirements of the competent authority and provide the operator with the possibility of having the historical, current and predicted emission values for reporting, conducting evaluations and controlling the operational process at plant.

Essential evaluation criteria include:

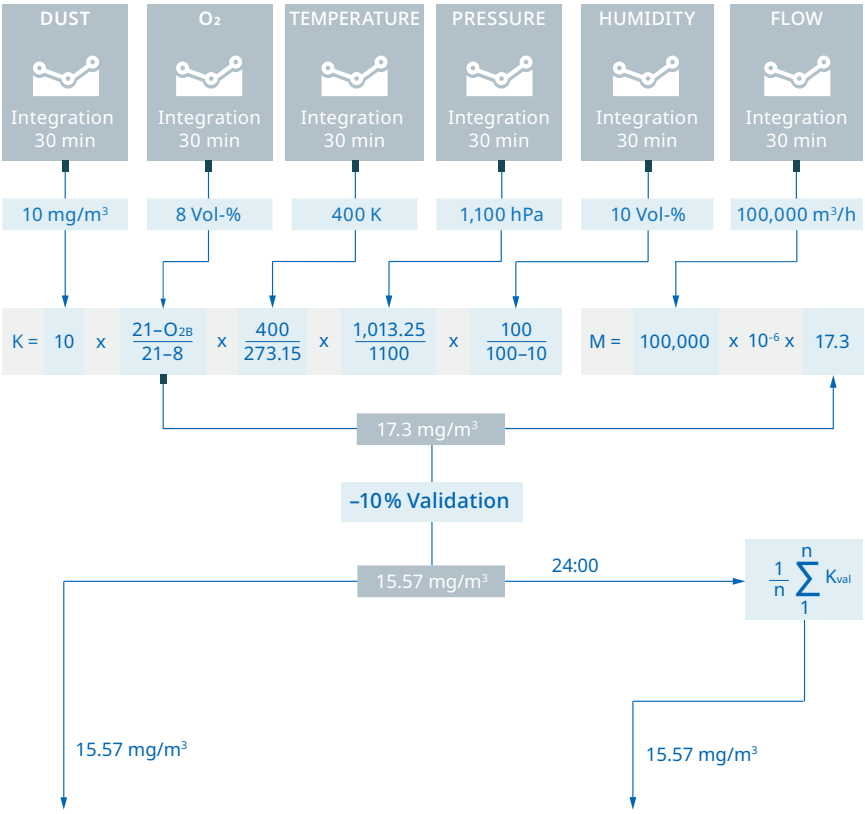
- Continuous acquisition of the parameters and reference values to be measured
- Generation of standardized, oxygen referenced integral values (10 min, 30 min, 60 min)
- Validation of the integral values (absolute, percentage)
- Generation of daily average values (48 h average values, monthly average values) from the validated integral values
- Monitoring of equipment failure (maintenance/fault) and logging in the daily and annual statistics
- Monitoring of the valid calibration ranges and evaluation/logging in accordance with EN 14181
- Monitoring of drift and precision of the continuously operating analyzers (control charts) in accordance with EN 14181

VALIDATION

The (half-)hourly average value is validated at the end of the integration interval from the integral values of the raw measurement data by subtracting the measurement uncertainty as a constant value, derived from the calibration (at 95% confidence interval) after the appropriate standardization (temperature, pressure) and oxygen reference value calculation, from the measurement value. Negatively validated average values will be set to zero.

The daily average values are formed as the arithmetic mean of the validated (half-) hourly average values.

VALIDATION



REPORTS

Concentration
- Minute values
- Integral values (e. g. 60')
- 24 h average value
- 48 h average value
- Weekly average value
- Monthly average value
- Yearly average value

Mass flow (totals/averages)
- Minute values
- Integral values
- 24 h value
- 48 h value
- Weekly average value
- Monthly average value
- Yearly average value

Statistics
- Limit values (percentile)
- Time in operation
- Time out of operation
- System availability (analyzers, evaluation system)

The integral values will be validated by subtraction of the confidence interval at 95%. The daily averages will be calculated from the validated integral values.

As requirements, IED 2010/75/EU stipulates maximum values of measurement uncertainty for continuous measuring equipment and validation of the measurement results. Until now, confidence and tolerance ranges of at least 5% or 10% were defined for measurement uncertainty. These confidence and tolerance ranges are now inapplicable. The validated (half-) hourly and daily average values are determined on the basis of measured (half-) hourly average values after subtraction of the confidence interval determined by calibration (measurement uncertainty/variability).

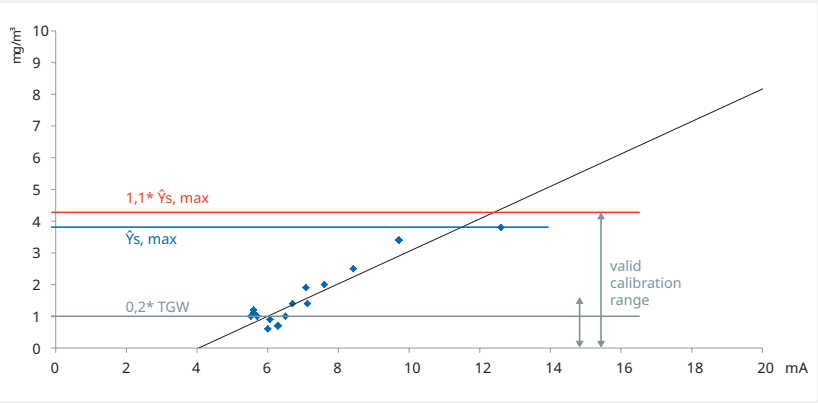
The value of the 95% confidence interval for an individual measurement result must not exceed the following percentages of this emission limit stipulated for the daily average value:

Carbon monoxide (CO)	10%
Sulfur dioxide (SO_2)	20%
Nitrogen oxide (NO_x)	20%
Total dust	30%
Total organic carbon (TOC)	30%
Mercury (Hg)	40%
Hydrogen chloride (HCl)	40%
Hydrogen fluoride (HF)	40%

VALIDITY OF THE CALIBRATION CURVE

Determination of the calibration curve for the measuring instrument using a standard reference method under different operating conditions (fuels, load, etc.) without manipulation of the furnace or filter systems (adjusting the burner, slitting the filter hoses or reducing the capacity of the electrostatic reaccreditation).

Calibration of the measuring instrument using a minimum of 15 measuring points distributed over 8–10 hours on 3 days. The long period should take all possible aspects of proper operation of the plant into account. The validity range for the calibration is specified in the calibration report.
Validated average values outside the valid calibration range (No. 6.5 EN 14181) are to be stored with the associated time and with their status and are to be logged at the end of the day and year. In the short period class, the percentage exceedance of the valid calibration range in the current week (Mon–Sun) is registered and the number of weeks with excessive percentages is registered in the long period class.



D-R 320

- Calibration function only valid within the calibration range
- Valid calibration range between 0 and Ŷs, max plus an extension of 10% of Ŷs, max or to 20% of ELV, whichever is greater
- New calibration QAL2 necessary within six months if >5% of all values per week lie above the valid calibration range for more than 5 weeks or >40% of all values lie above the valid calibration range for at least one week
- Extrapolation of higher values permitted

LOGGING AND DOCUMENTATION FOR VERIFICATION

- Daily reports with all integral values including status information
- Monthly reports with all daily average values including status information
- Annual reports with all monthly average values including status information
- Statistics reports with information on limit value exceedances, availability of the AMS, failure of waste gas cleaning equipment and the emitted emission quantity
- Documentation of failure of the AMS for the operator's information
- CUSUM, Shewhart or EWMA card to verify drift and precision of the AMS at the zero point and reference point
- Complete documentation of the AMS by the operator in accordance with point 9 of Annex C of EN 14181

Correct and legally compliant evaluation/ reporting of continuous measurement and calculation data is no longer possible manually. Modern computer-based evaluation systems are essential for fulfilling the specific requirements. These systems are preprogrammed according to the plant type; they acquire, calculate and report all emission-relevant data in accordance with legal requirements and the specifications of the local authorities.

A special form of evaluation is prescribed in Germany and can also be activated to expand the EU standard evaluation.

Classification (required by authority in Germany)
Although all integral values are stored along with the plant and channel status, the principle of classification is still maintained. Classification documents the class frequency distribution for the whole year on a single page in a clearly identifiable way. Limit value exceedances with reference to pollutants are identifiable at a glance. Classification must be referenced to a time starting at 00:00. As an alternative to issuing classification tables, the integral values determined can also be issued as daily, monthly and annual tables.

The daily average values are to be determined for the interval from 00:00 to 24:00 if at least 12 valid half-hourly average values are available.

All days on which more than 5 half-hourly average values or 3 hourly average values are unavailable due to faults or maintenance of the continuous measurement system are declared invalid. If more than 10 days a year are declared invalid for these reasons, the competent authority must oblige the operator to introduce suitable measures to improve the reliability of the continuous monitoring system.

Stationary source emissions – quality assurance of AMS data
European minimum requirements for data acquisition and handling systems (DAHS)
This European standard specifies requirements for the handling of data produced by an AMS. The main points covered by the standard include for example raw data acquisition, raw data validation, data correction, data averaging, data security, data alarms, data archiving, data display, data access, program validation, data reporting and program integrity.

It specifies the minimum requirements for the handling of AMS data, supporting the requirements of EN 14181 and legislation, for example EU directives such as IED and MCP. The standard does not preclude the use of additional features and functions, provided that the minimum requirements of this standard are met and that these features do not adversely affect data quality, clarity or access.
The scope of this standard begins at the final data output terminals of the AMS and covers the entire process leading to and including the presentation of data to the competent authority.

The EN 17255 standard is divided into:

Part 1: Specification of requirements for the handling and reporting of data

Part 2: Specification of requirements on data acquisition and handling systems

Part 3: Specification of requirements for the performance test of data acquisition and handling systems

Part 4: Specification of requirements for the installation and on-going quality assurance and quality control of data acquisition and handling systems

Raw data received in analog format (4 … 20 mA) or as digital communication (e. g. Modbus, Profibus, OPC) from any AMS or PEMS output must be continuously sampled at a rate fast enough to ensure no loss in information.

Sampling can never be slower than 1 sample per 10 seconds from each individual source (each individual AMS, typically 1 second sampling rate).

FLD: First level data
Raw data including status signals or average values calculated from the raw data including status signals. Sampling rate not slower than 1 per 10 seconds. Storage in DAHS for at least 5 years in auditable form.

SFLD: Standardized first level data
First level emission data calibrated and normalized using first level peripheral data (these values are not for reporting, but for information for the operator).

AFLD: Averaged first level data
Calculated for the STA averaging time from all valid FLD values.

STA: Short-term averages
(Typically 10, 30, 60 minutes) are calculated from first level data if 2/3 or more FLD-values are available. Verification that STA is within the calibration range (EN 14181 QAL2). Storage in DAHS for at least 5 years in auditable form.

SSTA: Standardized short-term average
Short-term average of emission data calibrated and converted to standard conditions using short-term average peripheral data.

VSTA: Validated short-term average
Standardized short-term average with the relevant confidence interval subtracted to comply with EU directive reporting requirements.

VLTA: Validated long term average
(Typically daily, 48-hourly, weekly, monthly, yearly). The averages are calculated from validated short-term averages. Valid if ¼ or more VSTA-values are available, storage in DAHS for at least 5 years in auditable form.

Depending on the regulations, averages can be calculated as block averages and/or rolling averages

First level data (FLD)
The FLD values are the first set of data to be stored in permanent storage. Data in FLD-storage can be identical to the raw data, i. e. unprocessed as received from the AMS or PEMS, or can be scaled to units representing concentration or process parameters.

Standardized first level data (SFLD)
The SFLD is determined by applying the calibration function and the conversion to standard conditions directly to the FLD. This provides a short time period data set, which can be used by the operator for process/abatement control or optimization. The DAHS must make it clear that averaging this SFLD over the STA period could give a different answer to the SSTA and must not be used for compliance assessment.

Averaged first level data (AFLD)
The averaged first level data must be calculated for the STA averaging time from all valid FLD values. Negative FLD values must be included in the calculation of the averaged FLD. If the FLD value is an average of raw data, the FLD average must be calculated from the FLD values weighted by the time coverage of each FLD value.

Short-term average (STA)
Short-term averages are the shortest period of averages the plant must report to the authorities. According to variations in different EU directives this can be 10 minutes, 30 minutes or 1 hour, depending on the type and application of the plant. The calibration function determined in QAL2 in accordance with EN 14181 must be used to calculate the short-term averages (STA) on the basis of the averaged FLD.
The STA must be evaluated if valid FLD is available for at least two thirds of the STA averaging time. The DAHS must automatically log and report monthly the periods where the measurement range has been exceeded, and the total time where data has been capped may not exceed 2% of the total operation time in each individual calendar month.

Standardized short-term average (SSTA)
The SSTA is calculated by normalizing the STA emission values with STA peripheral values, such as oxygen, temperature, pressure and moisture.

Validated short-term average (VSTA)
The validated STA (VSTA) must be calculated by subtracting the uncertainty from the standardized STA in accordance with the procedure laid down in the national legislation.

Note: The EU directives stipulate that, before reporting the concentration of any pollutant to the authorities, the measurement uncertainties in the form of 95% confidence intervals must be subtracted from the measurement value, for compliance reporting only. Different countries have different interpretations of this, and consequently different procedures for doing so. The method of subtracting and the value of the uncertainty must be stated in the report and stored in the event log.

Validated long-term averages (VLTA)
Long-term averages are any longer periods of averages the plant must report to the authorities. According to variations in different EU directives the averaging period can be 1 day, 1 week, 1 month, 1 quarter or 1 year, depending on the type and application of the plant.

The long-term average is calculated as the arithmetic mean of sufficient numbers of validated short-term averages (VSTA), to make up the period of the long-term average.

If the plant operator is required to report according to legal local time (LLT), the daily average must be calculated as follows: For the day switching from LST to DST, where one hour is lost, the daily average must be calculated from the STA values within the 23-hour time period. For the day of the switch from DST to LST, where one hour is gained (duplicated), the daily average must be calculated from the STA values within the 24-hour time period.

QAL3 procedure
The QAL3 procedure should be performed in the DAHS, the necessary input data (measurement at zero and span point) must be entered either automatically or manually into the DAHS. The DAHS reporting must include all data related to the entire QAL3 process.

Calibration range check
Verification that the STA-measurement is within the calibration range as specified during the last valid QAL2 in accordance with EN 14181.

Standardization of concentrations and flue gas flow data
Measured concentrations must be standardized only as SSTA values (typically 10, 30, 60 minutes), since SSTA values are the only values validated by a calibration in accordance with the QAL2 procedure from EN 14181. Standardization can include:

- Correction to reference oxygen levels
- Correction for temperature
- Correction for pressure
- Correction for water vapor

The SSTA value for the pollutant mass flow must be calculated from SSTA values for the concentration and the flue gas flow under the same conditions. The annual emission is calculated by summation of the SSTA values for the pollutant mass flow.

Flue gas flows are used for example for the calculation of the pollutant mass flow for reporting to the authority or for calculation of the emission limit value in cases where two or more combustion plants are connected to one stack.

BLOCK AVERAGES

Where averages are 'block' type averages, periods will commence as detailed below

Averaging period	Starting time (unless otherwise specified by local legislation or permit)	Calculation basis
≤1 min for FLD	Minute averages start at the first second of the minute. Averages less than 1 min start at the first second of the minute and subsequent intervals, e.g. for a 5 s period at 0 s, 5 s, 10 s, 15 s etc.	Raw data
≤1 h for STA	Hourly averages start at the first minute of the hour. Averages less than 1 h start at the first minute of the hour and subsequent intervals, e.g. for a 10 min period at 0 min, 10 min, 20 min, etc.	FLD
1 day	Daily averages start at 00:00:00 LLT on the day.	VSTA
48 h	48-h averages start at 00:00:00 LLT.	VSTA
1 month	Monthly averages start at 00:00:00 LLT on the first day of the calendar month.	VSTA
1 year	Yearly averages start at 00:00:00 LLT on the first day of the calendar year.	VSTA

Rolling averages

Where averages are rolling averages, the average commences N periods prior to the actual moment in time that the period ends and has a resolution indicated in the table below. For example, for 10 min rolling averages, a value is recorded every minute that represents the average of the previous ten 1-min-averages.

Averaging period	Calculation frequency (unless otherwise specified by local legislation or permit)	Calculation basis (unless otherwise specified by local legislation or permit)
Multiples of periods less than 1 h, i.e. 10 min	Every FLD period	FLD
1 h	Every FLD period	FLD
1 day	Every STA period	VSTA
48 h	Every STA period	VSTA
1 month	Daily	VSTA
1 year	Monthly	VSTA

5 | SYSTEM D-EMS 2020 DATACEMS

SYSTEM D-EMS 2020, DATACEMS

D-EMS 2020 – A MODULAR SYSTEM FOR INDUSTRIAL PLANTS OF ANY SIZE

- QAL1 certified in accordance with EN 15267-2 by TÜV Rheinland
- Software available in more than 20 MCERTS certified languages

Emission evaluation in accordance with German requirements, the European directives (EU) 2015/2193 (MCP) & 2010/75/EU (IED), considering EN 14181:2014 and European minimum requirements EN 17255.

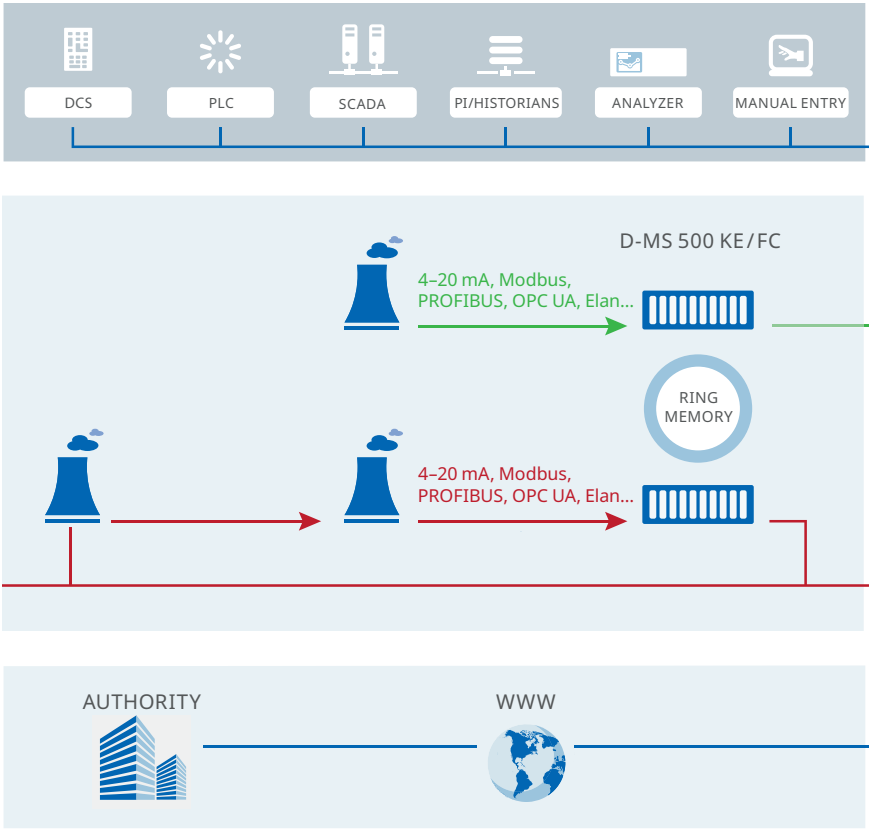
The D-EMS 2020 system can be freely configured according to the needs of the plant and the requirements of the operator. The system is modular, fulfills the current requirements, is prepared for future guidelines and can be easily extended after installation by further software modules and hardware components.
The heart of the D-EMS 2020 system is the server PC in an industrial design with the suitability tested D-EMS 2020 software. The use of server hard disks as a RAID array network ensure a high level of reliability and, in conjunction with the D-MS 500 FC data logger, enables compliance with the legally required availability of 99%.

The system can be composed of:
- The D-MS 500 FC data logger
- The D-MS 500 FC DIN rails
- A bus connection directly to the PC or via the D-MS 500 FC
- Or a combination of the above options

If the D-MS 500 FC data logger is used, there is intermediate data storage for up to 128 days. If the connection to the PC or the PC itself is faulty: after re-establishing communication, all data is automatically calculated and stored in the system in the correct chronological order, the official reports are created and remote emission monitoring transmission automatically executed without downtime.

Features
- Complies with European and US EPA based regulations
- Analog and digital data acquisition with long-term data storage in accordance with legal requirements
- Provision of data to customer systems via analog and digital interface
- Presentation of current, historical or forecast measurement data as bar or line chart and optionally in customer-specific design
- Standalone and client-server architecture, installation options to meet the various customer requirements
- Role-based user management, including LDAP(S)
- Additional modules such as GHG, QAL3, automatic backup

Benefits
- Scalable and modular system for all plant sizes and types
- Fully-featured modern system design
- Intuitive and easy-to-use interface
- Flexible configuration to meet the various customer requirements
- Powerful reporting with multiple customization options and e-mail notification

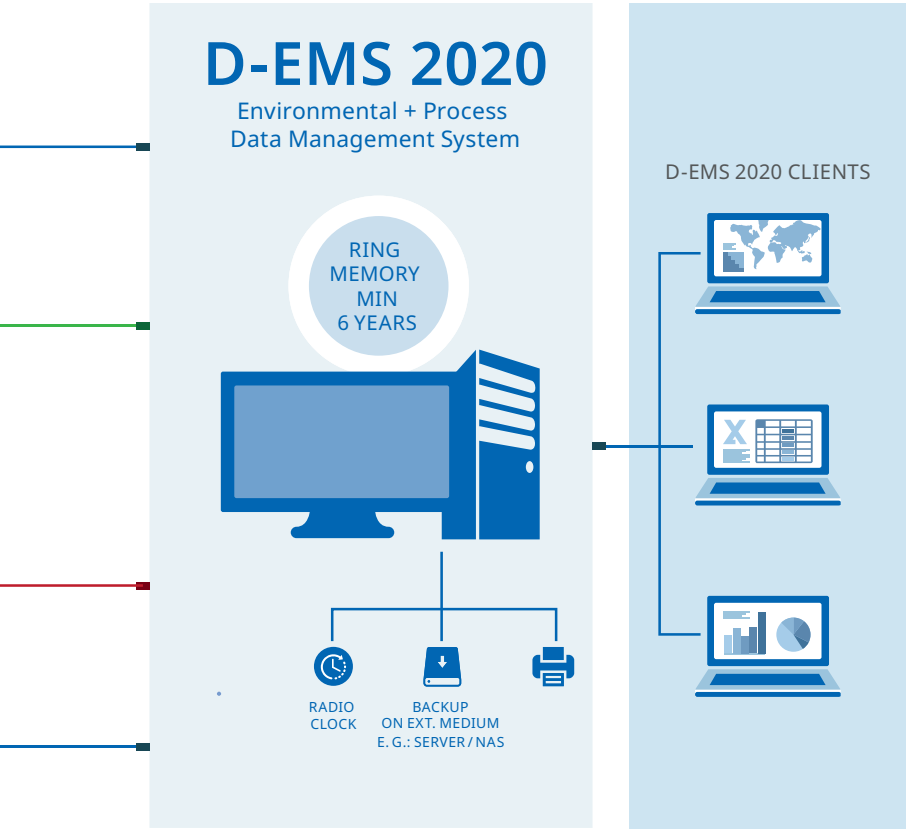


TECHNICAL DATA

Data acquisition
- Up to 1,024 analog inputs per server
- Up to 1,024 analog outputs per server
- Up to 2,048 analog inputs per server
- Up to 2,048 analog outputs per server
- Data acquisition can be carried out either directly or via data loggers in the D-MS 500 FC family to the server

Interfaces
- 4 ... 20 mA
- Modbus RTU/TCP
- PROFIBUS DP
- PROFIBUS Master (VDI 4201)
- PROFINET
- Elan
- OPC UA
- Mode 4
- Ethernet IP
- And others

Data export
- PDF, XLS, XML, CSV, ASCII files



TECHNICAL DATA

Data security

- Data buffer in the D-MS 500 FC data logger family with internal ring memory of up to 128 days
- Encrypted data communication between server and data loggers
- Encrypted and password protected SQL database
- Role-based user management, including LDAP(S)
- External data storage and backup (file server, NAS, etc.)
- Alarm notification on failure of a storage medium
- Internet/intranet connection: automatic data transfer to any web server on the Internet for visualization via HTML
- Daily data control

Visualization

- Reporting (daily, monthly, quarterly, yearly, and others)
- Bar and line charts with current and historical data
- Alarm and event management with comment functionality and e-mail notification

BASIC SYSTEM WITH THE D-MS 500 FC DATA LOGGER

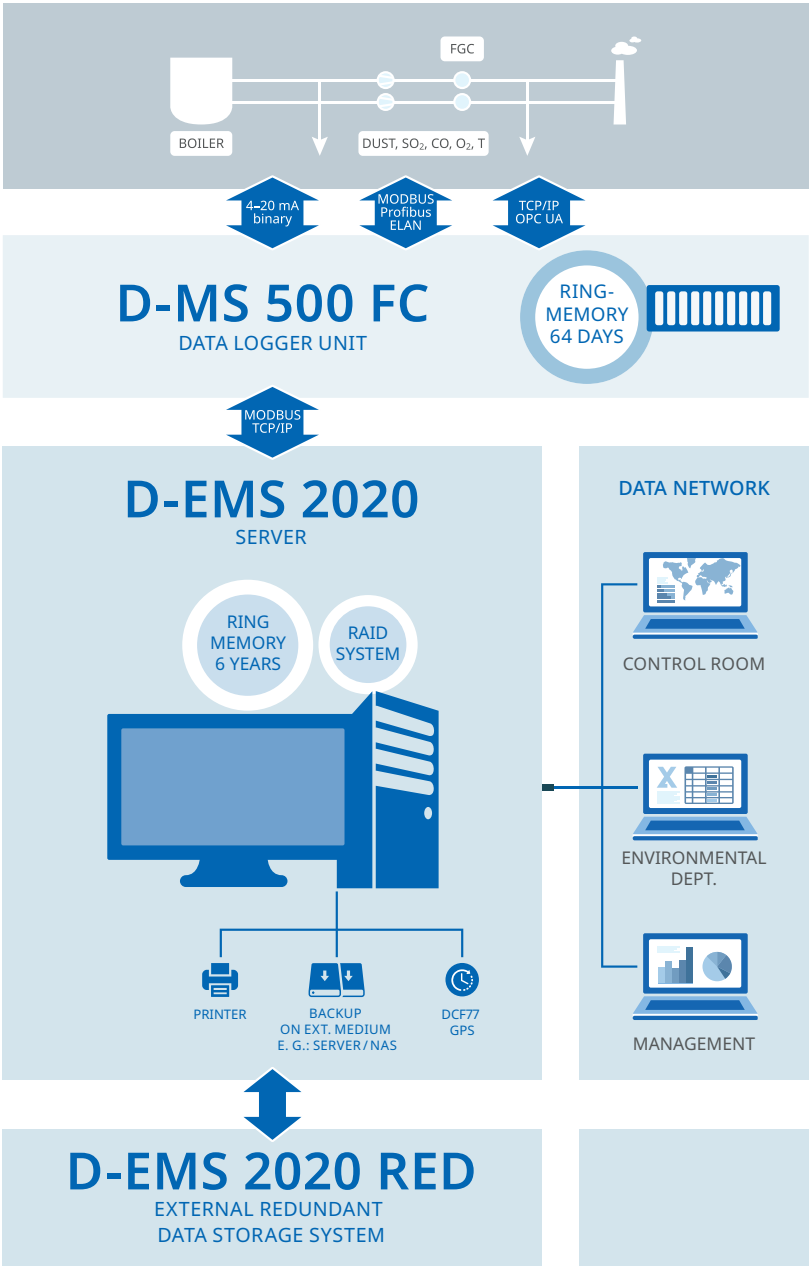
D-EMS 2020 server

- Windows-based and certified D-EMS 2020 software
- 19″ or tower PC in industrial design
- Windows 10/11 Pro or Windows Server 2019/2022

D-MS 500 FC data logger

- DIN/top hat rail mounting design
- 1 serial interface RS232/485
- 2 Ethernet RJ45 interfaces
- Internal memory 64 days, (optional 96/128 days)
- Operating voltage 24V DC, 100 W (single or redundant)

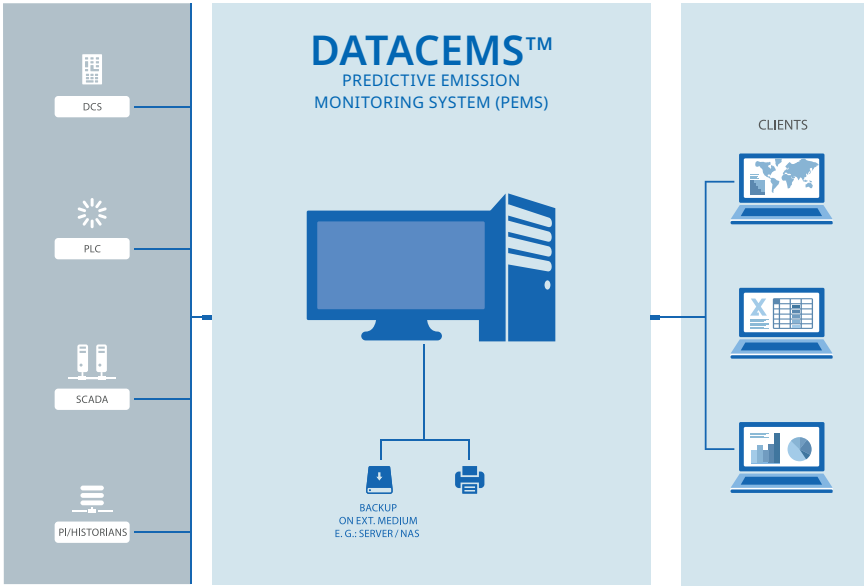
If the server fails or communication between the server and the data logger is interrupted, all raw values are temporarily stored in the data logger until the problems are resolved, and all data is then calculated and stored in the database.


FGC
BOILER
DUST, SO_2, CO, O_2, T
4–20 mA binary
MODBUS Profibus ELAN
TCP/IP OPC UA
D-MS 500 FC
DATA LOGGER UNIT
RING-MEMORY 64 DAYS
MODBUS TCP/IP
D-EMS 2020
SERVER
RING MEMORY 6 YEARS
RAID SYSTEM
PRINTER
BACKUP ON EXT. MEDIUM E. G.: SERVER / NAS
DCF77 GPS
DATA NETWORK
CONTROL ROOM
ENVIRONMENTAL DEPT.
MANAGEMENT
D-EMS 2020 RED
EXTERNAL REDUNDANT DATA STORAGE SYSTEM

Predictive emission monitoring system
Software-based predictive emission monitoring system (PEMS) for continuous real-time monitoring of pollutants such as NO_X, SO_2, CO, HC or reference variables such as O_2.

- PEMS are an innovative and cost-effective approach to continuous monitoring of emission sources as an alternative to continuous emissions monitoring systems (CEMS)
- The models are built with quality assured emissions training data along with paired, time-synchronized process parameter data with correlation to emissions
- Functionality: a predictive emission monitoring system cannot measure emissions directly and instead uses an empirical model to predict emissions based on real-time process data

Features
- Windows-based continuous and real-time monitoring of emissions
- Multiple PEMS engines on one server to cover multiple sources
- Multidimensional mathematical modeling (MdM_2) technology to compute the emissions
- Sensor validation system (SVS) to determine status and health of process sensor
- Performance criteria and reproducibility as per TS 17198
- Measurement frequency 1 second
- Response time: 99,9% less than 1 second
- Data availability 99% +
- All standard interfaces, e. g. OPC UA, PI, Modbus, PROFIBUS, etc.
- Executable on standard server and workstation hardware


DCS
PLC
SCADA
PI/HISTORIANS
DATACEMS™
PREDICTIVE EMISSION
MONITORING SYSTEM (PEMS)
BACKUP
ON EXT. MEDIUM
E. G.: SERVER / NAS
CLIENTS

PEMS IN A NUTSHELL

Predictive emission monitoring (PEM) is a novel and cost-effective approach to continuous monitoring of source emissions as an alternative to continuous emission monitoring systems (CEMS). To be accepted as a full compliance solution, PEM must be strictly in line with applicable regulations for source monitoring.

PEM systems (PEMS) are software-based. This means that they do not need gas analyzers and associated hardware like sample conditioning or shelters. Interfaced with plant control systems, PEMS utilize process inputs to offer continuous, real-time monitoring of pollutants, such as NOx, SO2, CO, HC, or diluents such as O2 and CO2. PEMS are generally suitable for all gas and oil-fired emission sources as an alternative to continuous emission monitoring systems (CEMS), providing equal accuracy and data quality. The models are built with quality assured emissions training data along with paired, time-synchronized process parameter data with correlation to emissions.
PEMS are frequently packaged with data acquisition and handling systems (DAHS) to create self-sufficient compliance solutions. Applications are available for utilities, petrochemical, chemical, steel and other industrial plants or municipal sites. PEMS offer significant cost benefits with lower capital expenditures as well as much lower operational and maintenance cost than CEMS. PEMS and DAHS require little or no plant workforce for operation.

However, to be recognized as a certifiable, accepted equivalent to CEMS, PEMS must be based on sound regulatory frameworks and adhere to the requirements of a demonstrable, stringent quality assurance scheme. The United States Environmental Protection Agency (EPA) has stipulated Performance Specification (PS) 16 as the main normative document within 40 CFR Part 60.

For Europe, Working Group 37 of CEN/TC 264 “Air Quality” has prepared the technical specification (TS) CEN/TS 17198 for PEMS, which was published in 2018 and reviewed for the first time in 2022. It takes account of the relevant European standards EN 14181 and EN 15267. For Germany, the VDI/DIN Commission on Air Pollution Prevention (KRdL) will publish an expert recommendation on the subject of PEMS in 2024 (VDI EE 3952). This document will also be available in English.
At present, PEMS is used mainly in countries following U.S. EPA regulations, because these standards have already been in place for some years and demonstration programs have been completed. Consequently, the technology is already used at many plant sites, not only in the United States, but also in the Middle East and Asia. Some countries in Europe have also started using PEMS for a variety of plants, including the UK, Netherlands and Sweden, and some installations are already in place in Germany.
PEMS installations can be found as standalone compliance solutions or as part of an integrated environmental monitoring approach capable of addressing multiple sources in one plant. One prerequisite is seamless integration of PEMS and DAHS in plant-wide IT and communication networks. As an additional benefit, PEMS provides data to lower emissions and improve combustion efficiency as a viable diagnostic tool.
Cost savings due to lower capital expenditures, as well as much lower operating and maintenance costs, provide a strong incentive to replace CEMS with PEMS. This incentive is based on the fact that PEMS can accomplish equal accuracy and quality of emissions data compared to CEMS. Return on investment (ROI) can be achieved in just a few years.

CEMS – PEMS COMMON FEATURES

Continuous	Both methods can be used for continuous emission monitoring.
Plant types	For all oil- and gas-fired sources.
Accuracy/ precision	Accuracy and precision are comparable, provided that the same quality assurance scheme is applied.
Quality assurance	Assurance of data quality comparable to CEMS with procedures from 40 CFR Part 60 RATA/RAA, as well as following the European standards EN 14181/EN 15267 (EU) and all PEMS-specific normative documents such as Performance Specification 16 (PS-16).
Data acquisition	For data representation and reporting of monitoring results, the same data acquisition and handling systems (DAHS) are suitable.

CEMS – PEMS DIFFERENCES

	AMS	PEMS
Hardware	• Gas analyzers • Accessories such as probes, heated lines, sample conditioning systems, racks, shelters, etc. needed	• Standard server or workstation hardware with means for data backup and ensuring data integrity and interfaces • PEMS can run on the same hardware as a DAHS, if regulations allow
Applicability	• CEMS more universally applicable • Plants fired with variable solid fuels • Coal-fired plants • Waste incinerators • Components such as particulate matter and Hg	• Predominately used for gas and oil-fired plants • Not suitable for variable solid, moisture absorbing fuels • Not applicable for example at waste incinerators • Restricted for coal-fired plants
Costs	• PEMS: Less capital expenditure (CAPEX) • PEMS: Considerably lower expenses for operation and maintenance (OPEX) • PEMS: Less staff required compared to CEMS • The cost difference for quality assurance is small, as the quality assurance scheme is usually quite similar (RAA/RATA or QAL2/QAL3/AST)	
Availability/ drift	• PEMS: drift smaller (determined only by the drift of the process sensors deployed) • PEMS: availability higher compared to CEMS (typically 99.5%+)	

OVERALL SYSTEM WITH ALL AVAILABLE SOFTWARE MODULES

DATACEMS	Predictive emissions monitoring system module (PEMS) – determination of current emissions based on historical emission data and current plant/process parameters.
D-EMS 2020 AMS Control	Tool for free configuration of flow control for: zero or test gas supply for automatic AMS calibration, back purging of sample gas pipes/pitot tubes and others. Various valve controls including automatic/manual control options.
D-EMS 2020 Auth	Module for transferring data in ASCII, CSV, PDF, XLS, XML and other formats via SFTP to the authority over the Internet.
D-EMS 2020 Cloud	SSL-secured access to measured and calculated data and reports on the Internet from anywhere.
D-EMS 2020 GHG	Module for collection, evaluation, reporting and visualization of current and historical GHG output of fossil-fired combustion plants in accordance with the European greenhouse gas emission allowance trading scheme (2003/87/EG).
D-EMS 2020 MDE	Manual data entry module for any pre-set/discontinuous values.
D-EMS 2020 QAL3	Module for complete documentation of the AMS, acquisition and evaluation of drift/precision (QAL3) in accordance with EN 14181:2014, with automatic creation of the CUSUM, Shewhart or EWMA control chart.
D-EMS 2020 RED	External, physically separated, redundant data storage on a NAS.
D-EMS 2020 RWS	Electronic acquisition and display of raw values, sampling rate 1/s, 12-bit accuracy.
D-EMS 2020 CSM LT	Module to create your own data visualization dashboard.
D-EMS 2020 Web	Module for HTML-based presentation of selected values and reports on a web server on the Internet/intranet.

6 | MEASURING DEVICES FOR EMISSIONS + AMBIENT AIR

PROCEAS LASERCEM | MODULAR MULTI COMPONENT GAS ANALYZER

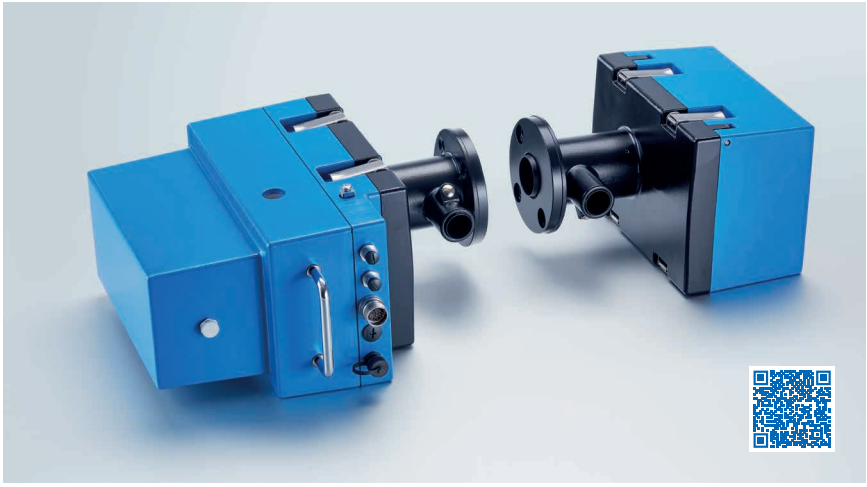
- Continuous multigas measurement
- Modular infrared laser spectrometer with high resolution using the patented OFCEAS-TDL technology and the patented low-pressure sampling system
- Low maintenance optical system with no moving parts
- Low operating cost by low-pressure sampling system without sample gas cooler, direct measurement without modifying the sample
- QAL1 certified in accordance with EN 15267
- EN 14181 certified QAL3 procedure

Continued on next page

Component**	Certified measuring range*	Maximum measuring range
CO (mg/m³) CO (L) (mg/m³)	0 ... 75; 0 ... 1,249 0 ... 30; 0 ... 250	0 ... 3,000
CO_2 (% vol)		0 ... 20
NO (mg/m³)	0 ... 78; 0 ... 150 0 ... 2,008	0 ... 3,000
NO_2 (mg/m³)	0 ... 40; 0 ... 100	0 ... 2,000
N_2O (mg/m³)		0 ... 500
HF (mg/m³)	0 ... 1.5; 0 ... 10	0 ... 100
SO_2 (mg/m³)	0 ... 75; 0 ... 2,858	0 ... 5,000
HCl (mg/m³)	0 ... 15; 0 ... 98	0 ... 150
NH_3 (mg/m³)	0 ... 15; 0 ... 45 0 ... 76	0 ... 500
CH_4 (mg/m³)	0 ... 5; 0 ... 20	0 ... 500
O_2 (% vol)	0 ... 21	0 ... 25
H_2O (% vol)	0 ... 30; 0 ... 40	0 ... 60
H_2S (mg/m³)		0 ... 7,500 0 ... 100
CHOH (mg/m³)		0 ... 30 0 ... 5

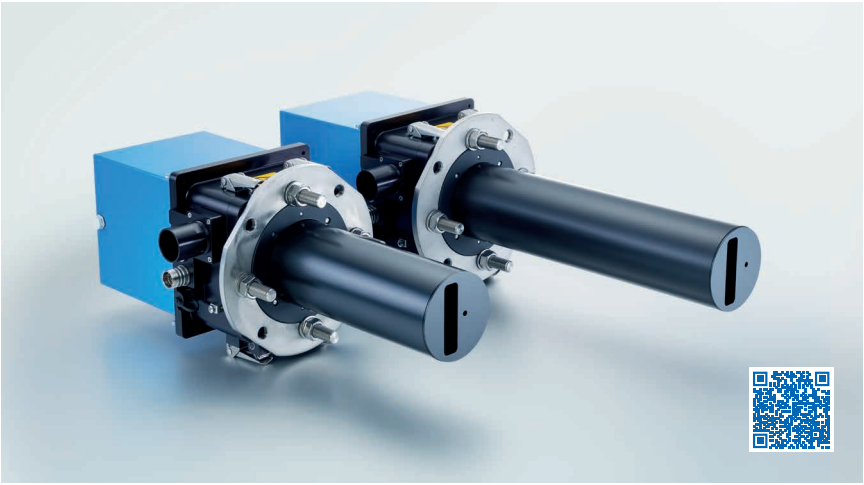
* *QAL1 + MCERTS*

** *Measure is displayed at 1,013.25 hPa and 0 °C*



- Continuous and contactless measurement of dust concentration
- Ideal for medium to large dust concentrations
- Automatic zero and reference point check
- Automatic contamination check and correction
- QAL1 certified in accordance with EN 15267

Measuring variable	Dust concentration, opacity
Measuring range	Opacity: Minimum 0 ... 20%, maximum 0 ... 100% Dust: Minimum 0 ... 80 mg/m³, maximum 0 ... 4,000 mg/m³
Smallest certified measuring range	0 ... 15 mg/m³
Operating conditions	In duct: • Temperature: Up to +250 °C standard, others on request • Humidity: 0 ... 95% RH, non-condensing • Relative pressure: –50 ... +20 hPa
Inner duct diameter	1 ... 18 m
Ambient temperature	–40 ... +60 °C



- Continuous and contactless measurement of dust concentration
- Ideal for small to medium dust concentrations
- One-sided installation without optical alignment
- Automatic zero and reference point check
- Automatic contamination check and correction
- QAL1 certified in accordance with EN 15267

Measuring variable	Dust concentration
Measuring range	Minimum 0 ... 5 mg/m³ Maximum 0 ... 200 mg/m³
Smallest certified measuring range	0 ... 7.5 mg/m³
Operating conditions	In duct: • Temperature: Up to +600 °C • Humidity: 0 ... 95% RH, non-condensing • Relative pressure: –50 ... +50 hPa
Inner duct diameter	>0.7 m
Ambient temperature	–40 ... +60 °C

- Continuous measurement of dust concentration
- Ideal for small to medium dust concentrations
- One-sided installation without optical alignment
- Automatic zero and reference point check
- Automatic contamination check and correction
- QAL1 certified in accordance with EN 15267

Measuring variable	Dust concentration
Measuring range	Minimum 0 ... 5 mg/m³ Maximum 0 ... 200 mg/m³
Smallest certified measuring range	0 ... 7.5 mg/m³
Operating conditions	In duct: • Temperature: Up to +350 °C • Humidity: 0 ... 95% RH, non-condensing • Relative pressure: –50 ... +50 hPa
Inner duct diameter	>0.3 m
Ambient temperature	–40 ... +60 °C

- Continuous measurement of dust concentration in wet gases
- Ideal for small to medium dust concentrations
- Extractive measurement, dilution of the sample gas
- Automatic zero and reference point check
- Automatic contamination check and correction
- QAL1 certified in accordance with EN 15267

Measuring variable	Dust concentration
Measuring range	Minimum 0 ... 5 mg/m³ Maximum 0 ... 200 mg/m³
Smallest certified measuring range	0 ... 7.5 mg/m³ 0 ... 15 mg/m³ 0 ... 45 mg/m³ 0 ... 100 mg/m³
Operating conditions	In duct: • Temperature: 0 ... +160 °C • Humidity: 0 ... >100% RH • Relative pressure: –50 ...+50 hPa
Inner duct diameter	>0.2 m
Ambient temperature	–40 ... +60 °C

- Continuous mercury analysis
- QAL1 certified in accordance with EN 15267
- Process control of mercury mitigation measures with speciation option
- Low instrument air consumption
- Internal reference gas generator for automatic reference point check
- Maintenance: fast system cooling and heating

Measuring variable	Total mercury concentration
Measuring range	0 … 15 µg/m³, 0 … 45 µg/m³, 0 … 75 µg/m³, 0 … 400 µg/m³, 0 … 3,000 µg/m³ (depending on design)
Smallest certified measuring range	0 … 15 µg/m³ *
Operating conditions	In duct: • Temperature: Up to +300 °C • Humidity: 0 … 100% RH • Relative pressure: –50 … +20 hPa
Inner duct diameter	>0.5 m
Ambient temperature	Analyzer: 0 … +50 °C Probe: –20 … +50 °C

** For large combustion plants and waste incinerators*

- Continuous measurement of flow velocity
- Versions for use at extremely high temperatures or in corrosive gases available
- One-sided or installation on both sides possible
- Cost effective measuring system
- Representative measurement even under difficult flow conditions
- QAL1 certified in accordance with EN 15267

Measuring variable	Flow velocity, volume flow
Measuring range	Flow velocity: 3 ... 50 m/s
Certified measuring range	3 ... 30 m/s, 3 ... 50 m/s
Operating conditions	In duct: • Temperature: up to +450 °C, others on request • Humidity: 0 ... 95 % RH, non-condensing • Relative pressure: –50 ... +50 hPa
Inner duct diameter	0.4 ... 9 m
Ambient temperature	–20 ... +50 °C

- Continuous and contactless measurement
- Corrosion-resistant ultrasonic transducer
- Ideal for saturated or aggressive flue gases
- Automatic zero and reference point check
- Representative measurement even under difficult flow conditions
- QAL1 certified in accordance with EN 15267

Measuring variable	Flow velocity, volume flow
Measuring range	Flow velocity: 0 ... 40 m/s
Certified measuring range	0 ... 30 m/s
Operating conditions	In duct: • Temperature: Up to +300 °C • Humidity: 0 ... 100 % RH, condensation allowed • Relative pressure: –50 ... +20 hPa
Inner duct diameter	0.5 ... 14 m, dependent on flue gas and installation conditions
Ambient temperature	–40 ... +60 °C

- Optical measuring cell, 72 logarithmically equidistant size channels
- PSL traceable particle sizing in accordance with ISO 21501-1
- Conformity in accordance with DIN EN 16450, VDI 4202-1
- Low-maintenance sampling design with improved inlet efficiency at high wind speeds and adaptive heating for optimized sample air conditioning
- Output of six dust mass fractions PM_{10}, PM_4, $PM_{2.5}$, PM_1 and PM_{coarse} and also particle concentration, particle number size distribution and meteo sensor data
- Intuitive operation via graphical user interface (touch display)

Measuring variable	TSP, PM_{10}, PM_4, $PM_{2.5}$, PM_1, PM_{coarse}
Measuring range	0 ... 12,000 µg/m³ for PM_{10} 0 ... 5,100 µg/m³ for $PM_{2.5}$
Particle size range	0.178 µm ... 29.4 µm
Sample gas	Ambient air: • Temperature: –40 ... 60 °C • Relative humidity: 100% (–40 °C) ... 30% (60 °C) or absolute humidity maximum 60 g/m³ • Air pressure: 530 ... 1,080 hPa
Data protocol (ASCII)	• GRIMM-protocol • Modbus TCP • GESYTEC/Bayern-Hessen protocol

7 | GLOSSARY, DOWNLOADS + SOURCE REFERENCES

GLOSSARY

AFLD	Averaged first level data
AM	Approval methodology
AMS	Automated measuring system
AST	Annual surveillance test
BAT	Best available techniques
BImSchV	Ordinance on the Implementation of the Federal Imission Control Act German: Verordnung zur Durchführung des Bundes-Immissionsschutz-gesetzes
CEN	European Committee for Standardization French: Comité Européen de Normalisation
CER	Certified emission reduction
CLRTAP	Convention on long-range transboundary air pollution
CUSUM	Cumulative sum control card
DAHS	Data acquisition and handling systems
EEA	European Economic Area
EIPPCB	European Integrated Pollution Prevention and Control Bureau
ELV	Emission limit value
EN 14181	Stationary source emissions – Quality assurance of automated measuring systems
EN 14956	Air quality – Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty
EN 15259	Air quality- Measurement of stationary source emissions – Requirements for measurement sections and sites and for the measurement objective, plan and report
EN 15267	Air quality – Certification of automated measuring systems, Part 1–3
EN 17255	Stationary source emissions – Data acquisition and handling systems, Part 1–4
EPA	Environmental Protection Agency

Continued on next page

GLOSSARY

EPLV	Environmental performance limit value
E-PRTR	European Pollutant Release and Transfer Register
EU ETS	EU Emission Trading System
FLD	First level data
IED	Industrial Emissions Directive – Directive 2010/75/EU of the European Parliament and of the Council of 24 October 2010 on industrial emissions (integrated pollution prevention and control)
IEP	Industrial Emissions Portal
ISO	International Organization for Standardization
ISO 10155	Stationary source emissions – Automated monitoring of mass concentrations of particles – Performance characteristics, test methods and specifications
LCPD	Large Combustion Plant Directive – Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants
LLT	Legal local time
LSU	Livestock unit
LV	Limit value
MCERTS	Monitoring Certification Scheme
MCP	Directive (EU) 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants
NGO	Non-governmental organization
PEMS	Predictive emission monitoring systems
QAL	Quality assurance level
RATA	Relative Accuracy Test Audit – US EPA
SAG	Desulfurization rate German: Schwefelabscheidegrad
SFLD	Standardized first level data

GLOSSARY

SRM	Standard reference method
SSTA	Standardized short-term average
STA	Short-term average
TI Air	Technical Instructions on Air Quality Control German: Technische Anleitung zur Reinhaltung der Luft TA Luft
TOC	Total organic carbon
TÜV	Technical Inspections Organization German: Technischer Überwachungsverein
TWG:	Technical working group
UNFCCC:	United Nations Framework Convention on Climate Change
VDI	The Association of German Engineers German: Verein Deutscher Ingenieure e. V.
VLTA	Validated long-term average
VSTA	Validated short-term average
WID	Waste Incineration Directive – Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste

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