Environmental permitting technical guidance PG1/1(21)

Reference document for combustion plant of 20 to 50 MW thermal capacity

1 Legal status

1.1 This technical guidance applies to the whole of the UK. It's issued by the:

- Secretary of State for Environment, Food and Rural Affairs,
- Welsh Ministers
- Scottish Government
- Department of Agriculture, Environment and Rural Affairs in Northern Ireland (DAERA).

1.2 This is issued as guidance in Scotland and as statutory guidance in:

- in England and Wales under regulation 65(1) of the Environmental Permitting (England and Wales) Regulations 2016
- in Northern Ireland under regulation 41(1) of the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013.

If there is an appeal against a decision made under this legislation, this guidance will be taken into account when making a judgement.

1.3 This technical guidance replaces:

- PG1/3(12), Statutory Guidance for Boilers and Furnaces 20–50MW thermal input
- PG1/4(11), Statutory Guidance for Gas Turbines 20–50MW Thermal Input
- PG1/5(95), Secretary of State's Guidance-Compression Ignition Engines, 20–50 MW Net Rated Thermal Input

2 Scope

2.1 England and Wales

This guidance applies to activities described in 'Schedule 1, Part 2, Chapter 1, Section 1.1, Part B (a) of the Environmental Permitting (England and Wales) Regulations 2016'. That is burning any fuel in a boiler, furnace, gas turbine or compression ignition engine with a net rated thermal input of 20 or more megawatts, but less than 50 megawatts.

Scotland

This guidance applies to the activity described in 'Schedule 1, Part 1, Chapter 1 Section 1.1 of the Pollution Prevention and Control (Scotland) Regulations 2012'. That is burning of any fuel in a:

A. boiler or furnace with a rated thermal input of 20 or more megawatts, but less than 50 megawatts
B. gas turbine or compression ignition engine with a rated thermal input of 20 or more megawatts, but less than 50 megawatts

Northern Ireland

This guidance applies to the activity described in 'Schedule 1, Part 1, Chapter 1, Section 1.1 of the Pollution Prevention Control (Industrial Emissions) (Northern Ireland) Regulations 2013'. That is burning any fuel in a boiler, furnace, gas turbine or compression ignition engine with a net rated thermal input of 20 or more megawatts, but less than 50 megawatts.

2.2 This guidance does not apply to those plants of between 20 and 50MW thermal input where they are one of a number of appliances with an aggregate rated thermal input of 50MW or more, operated on the same site by the same operator.

These plants should be treated as a single appliance with a rated thermal input of 50MW or more for the purpose of Section 1.1 Part A(1)(a) (Part A in Scotland and Northern Ireland).

2.3 This guidance does not cover compliance with the EU Energy Efficiency Directive (EED) (2012/27/EU).

In England and Wales, where 2 or more appliances with an aggregate net rated thermal input of 20 or more megawatts are operated on the same site, by the same operator, appliances must be treated as a single appliance with a net rated thermal input of 20 or more megawatts. This is to ensure these appliances carry out the cost-benefit analysis on co-generation (combined heat and power) required by the EED.

In Scotland, this is covered by a listed activity in Part B '(c) Burning any fuel in a combination of appliances with a total rated thermal input of more than 20 megawatts and less than 50 megawatts in an installation to which Schedule 1A applies'.

Therefore, this guidance does not apply to appliances with a rated thermal input of less than 20MW.

2.4 This guidance does not apply to any activities within the scope of Chapter III of the EU Industrial Emissions Directive (IED) (2010/75/EU). Chapter III of the IED does not apply to the activities in this guidance.

2.5 All plants within the scope of this guidance, except those described in 2.7, must also comply with the Medium Combustion Plant Directive (MCPD) (2015/2193/EU). The requirements of the MCPD are covered by Sections 4 and 5 of this guidance. Where the emission limit values (ELVs) and monitoring requirements of the previous guidance (see section 1.3) are more stringent than MCPD, these have been retained.

2.6 All plants within the scope of this guidance that were in operation before 20 December 2018, except those described in 2.7, must comply with MCPD rules for existing plants from 1 January 2025.

2.7 Plants that meet one of the criteria in Article 2(3) of the MCPD (for example a furnace where the gaseous products of the combustion are used for the direct heating, drying or any other treatment of objects and material), do not need to comply with the MCPD, but do still need a Part B permit.

2.8 In England and Wales, plants generating electricity are also classified as 'specified generators' and subject to additional controls set out in Schedule 25B of the Environmental Permitting (England and Wales) (Amendment) Regulations 2018 (SI2018 No.110). The requirements of Schedule 25B are covered by Sections 4 and 5 of this guidance. Where the ELVs and monitoring requirements of the previous guidance (see section 1.3) are more stringent than the ELV specified in Schedule 25B, these have been retained.

Specified generators are divided into 2 groups, Tranche A and Tranche B.

A 'Tranche A generator' is a plant or generator that:

- came into operation before 1 December 2016
- is the subject of a capacity agreement arising from the 2014 or 2015 capacity auctions (whether or not the generator came into operation before 1 December 2016)
- a Feed-in Tariff preliminary accreditation application was received by the Gas and Electricity Markets Authority before 1 December 2016

A generator ceases to be a Tranche A generator if it's the subject of a capacity agreement, or an agreement for provision of balancing services, where that agreement is entered into after 31 October 2017 and continues after 31 December 2018.

A 'Tranche B generator' is either:

- any generator that is not a Tranche A generator
- an 'excluded generator' (including a specified generator that has ceased to be a Tranche A generator) - see Schedule 25B to see what an excluded generator is

Back-up generators (that is generators operated solely to maintain power supply at a site during an on-site emergency, generally for fewer than 50

hours per year, for example for testing purposes) are excluded from generator controls.

Tranche B plants must comply with the statutory permit conditions including the relevant emission limit value.

Tranche A plants must comply with the statutory permit conditions (including the emission limit value) if:

- NO_X (Oxides of Nitrogen NO and NO_2, expressed as NO_2) emissions to air are currently greater than 500 mg/Nm^3 (15% O_2)
- they operate for more than 50 hours per year

All other Tranche A plants must comply with statutory permit conditions (including the emission limit value) from 1 January 2025.

Where a 1.1 Part B permit needs to be amended because the combustion plant includes a Tranche A or B generator, regulation will move from control of the local authority to that of the Environment Agency or Natural Resources Wales (NRW).

In Northern Ireland, the controls on specified generators are set out in Schedule 9B of the Pollution Prevention and Control Regulations. Schedule 9B generators are not divided into Tranches A and B. They are either:

- an existing generator - a generator with a rated thermal input equal to or greater than 1 megawatt and less than 50 megawatts that came into operation before 1 December 2016
- a new generator - any specified generator that is not an existing generator

In Scotland, there are no regulatory controls on specified generators.

2.9 In England and Wales, the regulator for plants that have to comply with MCPD or the specified generator controls is:

- in England, the Environment Agency
- in Wales, Natural Resources Wales (NRW)

For plants that do not need to comply with MCPD, the regulator will be the relevant local authority, unless part of an A(1) installation.

In Scotland, the regulator for all plants is the Scottish Environment Protection Agency (SEPA).

In Northern Ireland, the regulator is the:

- Northern Ireland Environment Agency (NIEA) for plants on a Part A or Part B installation
- relevant district council for all other plants (Part C), unless part of a Part A installation

In England and Wales, if a medium combustion plant (MCP) or specified generator is part of a Part B (for example metals or minerals) or Part A2 installation, the installation needs 2 environmental permits:

- one from the EA or NRW for the MCP
- one from the local authority for the Part B or Part A2 activities (without the MCP or specified generator (SG) included)

In Northern Ireland, if an MCP or specified generator is not part of a Part A or Part B installation, the operator needs 2 permits:

- one from the district council where the MCP/SG is located
- one from the Chief Inspector (NIEA) for the Part A or Part B activities

2.10 The rated thermal input is taken to mean the net ‘rated thermal input’. This is the rate at which fuel can be burned at the maximum continuous rating of the appliance, multiplied by the net calorific value (or lower heating value), and expressed as megawatts thermal.

3 General conditions

3.1 This guidance describes what are considered the best available techniques (BAT) for those activities within its scope. This guidance also details any mandatory requirements affecting air emissions. Unless otherwise stated, the provisions of this guidance are generally applicable.

3.2 The techniques in this guidance are neither prescriptive nor exhaustive. Other techniques may be used as long as they ensure at least an equivalent level of environmental protection.

3.3 Sections 4 and 5 set out a number of matters that should be considered for inclusion as permit conditions.

3.4 After assessing BAT and the environmental impact of emissions to air, permit conditions, including emission limit values, may need to be tighter than those set out in this guidance. In individual cases, it may be justified to:

- include additional conditions
- include different conditions
- not include conditions relating to some of the matters indicated

4 Summary of best available techniques

4.1 Control of emissions to air

4.1.1 To minimise and control emissions to air of CO and unburnt substances from combustion plants, BAT is to ensure an optimised combustion.

Optimised combustion is achieved by good design and operation of the equipment, including:

- optimisation of the temperature and residence time in the combustion zone
- efficient mixing of the fuel and combustion air
- combustion control, based on the continuous monitoring and automated control of appropriate combustion parameters (for example O_2, CO, fuel to air ratio and unburnt substances)

4.1.2 To minimise and control NOx emissions to air from combustion plants, BAT is to use one or a combination of the primary techniques in Table 4.1.

Table 4.1 Primary techniques for NO_x reduction

Technique	Description	Applicability
Choice of fuel	Use fuel (including support or auxiliary fuel) with a low content of potential pollution generating compounds (for example lower sulphur, ash or nitrogen content in the fuel)	The design of burners in existing plants may restrict the switch from liquid to gaseous fuels.
Staged combustion	Use staged combustion burners to achieve lower NOx emissions by staging the injection of either air or fuel in the near burner region. Dividing fuel or air reduces the oxygen concentration in the primary burner combustion zone, thereby lowering the peak flame temperature and reducing thermal NOx formation	Applicability may be restricted by space availability when upgrading small plants. Retrofitting fuel or air staging may reduce capacity.
Flue-gas recirculation (external)	Recirculate part of the flue-gas to the combustion chamber to replace part of the fresh combustion air. This reduces the oxygen content and cools the temperature of the flame	The existing plant design may prevent the application of this technique.
Flue-gas recirculation (internal)	Recirculate part of the flue-gas within the combustion chamber to replace part of the fresh combustion air. This reduces the oxygen content and cools the temperature of the flame	The existing plant design may prevent the application of this technique
Low-NO_x burner (LNB) and ultra-low-NO_x burner (ULNB)	Reduce peak flame temperatures, by delaying but completing the combustion, and increasing the heat transfer (increased emissivity of the flame). It may be associated with a modified design of the furnace combustion chamber.	The existing plant design may prevent the application of this technique

	The design of ultra-low NOx burners includes (air or) fuel staging and exhaust/flue-gas recirculation	
Use of inert diluents	Use 'inert' diluents (for example steam, water, nitrogen) to reduce the temperature of the flame either by: ● mixing with the fuel prior to its combustion ● injecting directly into the combustion chamber Steam injection may increase CO emissions	Generally applicable

4.1.3 If primary techniques are not enough to control NO_x emissions below the emission limit value, BAT is to use one of the secondary techniques in Table 4.2.

Table 4.2 Secondary techniques for NO_x reduction

Technique	Description	Applicability
Selective catalytic reduction (SCR)	Reduce NOx to nitrogen in a catalytic bed by reaction with ammonia (usually supplied as an aqueous solution) at an optimum operating temperature of around 300-450 ˚C. One or more layers of catalyst may be applied	The space available in existing plants may prevent the application of this technique
Selective non-catalytic reduction (SNCR)	Reducing NOx to nitrogen by reaction with ammonia or urea at a high temperature. The operating temperature window must be maintained between 900 ˚C and 1,050 ˚C	Existing process furnaces or heaters may not be able to achieve the temperature window (900-1,050 ˚C) and the residence time needed for the reaction

4.1.4 To prevent or reduce dust emissions to air from combustion plants, BAT is to use one or a combination of the techniques listed in Table 4.3.

Table 4.3 Techniques for dust reduction from combustion

Technique	Description	Applicability
Optimised combustion	See paragraph 4.1.1	Generally applicable
Choice of fuel	Use fuel with a lower pollution potential, for example liquid instead of solid fuel, gaseous fuel instead of liquid fuel	Existing plant design may restrict the switch from one type of fuel to another
Atomisation of liquid fuels	Use high pressure to reduce the droplet size of liquid fuel. Current optimal burner design generally includes steam atomisation	Applicable to liquid fuels

4.1.5 If these techniques do not control dust emissions below the emission limit value, BAT is to use one or a combination of the techniques in Table 4.4.

Table 4.4 Techniques for dust reduction from combustion

Technique	Description	Applicability
Cyclones/ Multicyclones	Use a set of dust control systems, based on centrifugal force, where particles are separated from the carrier gas	Solid fuel combustion plant
Electrostatic precipitator	Use electrostatic precipitators so particles are charged and separated under the influence of an electrical field	Solid fuel combustion plant
Bag or fabric filter	Pass gasses through a bag or fabric filters made from porous woven or felted fabric to remove particles	Liquid or solid fuel combustion plant
Ceramic or metal filter	Use a ceramic filter material. In metal filters, surface filtration is carried out by sintered porous metal filter elements	Liquid or solid fuel combustion plant

4.1.6 To prevent or reduce dust emissions to air from fuel and ash handling and storage, BAT is to use one or a combination of the techniques in Table 4.5.

Table 4.5 Techniques for dust reduction from fuel/ash handling and storage

Techniques	Description	Applicability
Dust arrestment	Use bag filters, cartridge filters	Silos
Dust suppression	Use dust covers, water or suppressants, well positioned spray guns. Ensure sprays have sufficient coverage	Fuel or ash stockpiles
Appropriate siting	Position away from site boundary, especially if near residential or other sensitive receptors	Outdoor operations, for example fuel stockpiles, conveyors and so on
Wind dynamics management	Use fencing, bunding, wind boards, enclosed conveyors, reduced drop heights, and so on	Outdoor operations, for example fuel stockpiles, conveyors and so on
Site and process design	Store stock indoors, below ground or in covered bins	Fuel stockpiles

4.1.7 To prevent or reduce SO_2 emissions to air from combustion plants, BAT is to use a fuel with a low sulphur content.

If the emission limit value cannot be achieved by fuel choice, BAT is to use a suitable abatement technique, for example wet caustic scrubbing or dry scrubbing (that is, in duct sorbent injection with hydrated lime or sodium carbonate or bicarbonate followed by dust abatement).

4.2 Control techniques for biomass combustors

4.2.1 Use fluidised bed combustion or travelling grates for lower emissions of NO_X. If the fuel is not suitable for fluidised bed combustion or a travelling grate, use a stepped grate boiler.

4.2.2 Other parameters influencing the choice of biomass combustor and its design include:

- purpose: energy generation, variation of load, CHP
- fuel: %biomass, high N CI, slagging characteristics
- form: briquettes, pellets, wood chips, hog fuel, wood logs, sawdust, shavings, bark, bales, energy grain, olive residues, fruit seed, and so on
- aquatic biomass, blends and mixtures
- fuel indexes

4.2.3 The effect of the parameters can include:

- high moisture content limiting by effect on heat balance
- difficult ash behaviour – slagging in the fire bed, and fouling on furnace and boiler surfaces
- difficult physical properties – bale handling equipment, metering and feeding materials to combustor
- deposit build up on boiler tubes, requiring removal for thermal and corrosion reasons

4.2.4 Techniques to predict fuel behaviour from bio-fuel analysis are still being developed.

4.2.5 Biomass combustor designs are actively being developed (for example control techniques include fuel and air staging, flue gas recirculation, fuel bed cooling).

4.3 Techniques to control emissions from storage and handling of fuels and ash

4.3.1 Deliver, move, remove and load materials to and from stockpiles, in a way that prevents emissions to the air.

4.3.2 Transport and handle dusty materials in the site in a way that prevents emissions to the air. For example, fit external above-ground conveyors carrying dusty materials with protection against wind whipping. Duct extracted air from the transfer point to suitable arrestment equipment.

4.3.3 Enclose or adequately sheet all vehicles transporting dry, dusty materials to or from a site.

4.3.4 Store all dusty materials in covered containers, purpose-built silos or undercover whenever practicable.

4.3.5 Store stockpiles of dusty or potentially dusty materials in a way that prevents wind whipping (for example by covering, screening or dampening).

4.3.6 Bulk fuel storage and silos should be fitted with a high-level alarm or volume indicator to warn of and prevent overfilling. For example, for chipped fuels:

- the high-level alarm should be electronically interlocked with the fuel delivery system to prevent overfilling
- deliveries of chipped fuels should be supervised at all times

Fit bulk fuel storage and silos with a high-level alarm or volume indicator to warn of and prevent overfilling. For example, for chipped fuels:

- supervise all deliveries
- electronically interlock the high-level alarm with the fuel delivery system to prevent overfilling

4.3.7 Connect solid fuel silo vents through suitable arrestment equipment.

4.3.8 Store all arisings of ash and other dusty materials in closed containers or buildings, or store in a wet state pending removal from site.

4.3.9 Use methods which minimise releases of dust to air for all on-site fuel processing activities, such as chipping, shredding, pulverising or screening, inside a building.

4.3.10 Bulk storage tanks for liquid fuels should be back vented to the delivery tank during filling. Where this is impractical, position displaced air vents in a way that prevents any offensive odours, as perceived by the local enforcing authority inspector at or beyond the site boundary.

4.3.11 Completely contain above-ground fuel storage tanks (for example by bunding impervious and resistant to the stored fuels and capable of holding 110% of the capacity of all storage tanks within the bund).

4.3.12 Contain and clear all spillages as soon as possible. For solid materials, use vacuum cleaning, wet methods or other appropriate techniques. Do not dry sweep.

4.4 Air quality, dispersion and dilution

4.4.1 Pollutants emitted via a stack need sufficient dispersion and dilution in the atmosphere. This ensures that they do not ground at concentrations which may be harmful to human health or the quality of the environment.

4.4.2 Emissions to air should be free from dark smoke (see section 5.4) and from offensive odour outside the site boundary, as perceived by the regulator. This can be achieved by good combustion.

4.4.3 All new and replacement plants must submit an air quality report detailing the long-term and short-term process contribution as part of their application. The process contribution can be calculated using the guidance in Air risk assessment for your environmental permit.

4.4.4 Emissions from the permitted process or installation must not cause or contribute to:

- EU air quality limit values being exceeded
- the values within the objectives of the air quality strategy for England, Scotland, Wales and Northern Ireland for sulphur dioxide, oxides of nitrogen and particulate matter (PM_{10} and $PM_{2.5}$) being exceeded

4.4.5 Regulators will impose tighter emission limits than those in Tables 5.2 to 5.6 where:

- air quality standards or objectives are being breached or are in serious risk of breach
- it's clear from the air quality report or detailed review and assessment (for existing installations) that the permitted process or installation is a significant contributor to the problem, (see paragraph 4.4.6)

The need for tighter emission limits might be offset, fully or in part, by increasing the stack height or exit velocity.

4.4.6 Ensure that the process contribution is no more than 1% of the relevant long-term Environmental Quality Standard (EQS) and 10% of the relevant short-term EQS at sensitive receptors.

Where this cannot be demonstrated through simple calculations, (for example, the air risk assessment in paragraph 4.4.3), the operator will need to use computer-based air dispersion models, for example ADMS (Advance Dispersion Modelling System), AERMOD (Atmospheric Dispersion Modelling) or some form of intermediate screening tool.

When calculating the impact of particulate emissions (PM_{10} and $PM_{2.5}$), data on particle size distribution of dust emissions may be needed. Otherwise, assume that all the dust emissions are present as PM_{10} or $PM_{2.5}$

4.4.7 To ensure dispersion is not impaired by either low exit velocity at the point of discharge or deflection of the discharge:

- the stack exit should be vertical
- do not use a cap or other restriction

A cone may sometimes be useful to increase the exit velocity to achieve greater dispersion.

4.4.8 Where necessary the regulator will include the minimum stack height and exit velocity within the environmental permit.

4.5 Emission testing

4.5.1 Where annual emissions testing is required, the operator must have suitable and sufficient monitoring locations for testing. Guidance on testing locations is in the Environment Agency's 'Technical Guidance Note (Monitoring) M1: Sampling requirements for stack monitoring'. The operator is advised to work with an emissions testing company before applying for a permit to ensure emissions monitoring can be carried out.

Operators who comply with the Environment Agency's Monitoring Certification (MCERTs) scheme for environmental permit holders, will meet the monitoring requirements of this guidance.

4.5.2 If necessary, the regulator should include permit conditions detailing the requirements for emissions testing, for example design and access.

4.5.3 Where emissions monitoring is required but cannot be safely or correctly undertaken, the regulator should refuse the permit.

4.6 Management

4.6.1 Effective management is central to environmental performance; it is an important component of BAT and in complying with permit conditions. Operators of installations should put in place a structured Environmental Management System (EMS) to cover:

- cleaning and maintenance
- staff training
- plant operation
- bottom ash storage and disposal
- emissions monitoring
- plant failures
- record keeping

If the operator already has accreditation to a published standard such as ISO 14001, they do not need to set up a separate system. Regulators should use their discretion, in consultation with individual operators, to agree the appropriate level of EMS for the nature and size of the process.

4.7 Cleaning and maintenance

4.7.1 Effective preventative maintenance and cleaning is important to comply with emission limits.

4.7.2 Clean flues and ductwork regularly to ensure that a build-up of material does not affect emissions and their dispersion.

4.7.3 Maintain all aspects of the process, including all plant, buildings and equipment, in line with manufacturer's recommendations. Where there are no manufacturer's recommendations, the operator should develop their own maintenance procedures.

4.8 Training and operation

4.8.1 All plants should be operated in accordance with the manufacturer's operating manual to minimise the risk of emissions. Where there is no manufacturer's operating manual, develop your own operating procedures which should include procedures on how to deal with plant failures.

4.8.2 Only trained staff must operate the plant.

4.9 Record keeping

4.9.1 The operator must keep written records of:

- all inspections, both by external bodies and internal employees

- maintenance, including cleaning, maintenance undertaken by external contractors or internal personnel, and breakdowns
- operating procedures with subsequent training records
- emission testing, periodic and operator assessment, and details of any testing platforms

The regulator will inspect these records as part of a site visit.

4.9.2 For medium combustion plants, the operator must also keep a written record of:

- the type and quantities of fuels used in the plant
- information proving the effective continuous operation of secondary abatement equipment needed in order to meet the emission limit values
- any malfunctions or breakdown of secondary abatement equipment

4.9.3 Keep records for a minimum of 6 years.

5. Emission limits, monitoring and other provisions

5.1 Emissions monitoring

5.1.1 Emissions of the substances listed in Table 5.1 must, where relevant, be controlled. The emission limit values and provisions described in this section are achievable using the best available techniques described in Section 4.

5.1.2 Operators must monitor emissions using the standard specified in table 5.1 or an equivalent method agreed by the regulator. Measure all pollutants with a set emission limit value f and for carbon monoxide or all plants.

Table 5.1 Emission monitoring frequencies and standards.

Substance/parameter	Standard [1, 2]	Minimum monitoring frequency [2]
Carbon monoxide	EN 15058	Once every year [5]
Dust [3]	EN 13284-1	
Oxides of Nitrogen (NO and NO_2, expressed as NO_2)	EN 14792	
Sulphur dioxide [4]	EN 14791	
Smoke (Ringelmann)	BS 2742:2009	Daily when in operation

[1] Standards are periodically amended, updated or replaced so you should check with the Source Testing Association. Further information on monitoring can be found in Environment Agency publications (M1) and (Monitoring Stack Emissions: Environmental Permits).
[2] Where continuous measurements are made, the relevant EN standards are EN 15267-1, -2 and -3 and EN 14181, which are applicable to all parameters.
[3] Monitoring of dust does not apply when combusting gaseous fuels only.
[4] In the case of emissions of sulphur dioxide from combusting fuels with a known sulphur content, monitoring can be replaced and emissions may be determined by calculation ensuring the provision of data of an equivalent scientific quality.
[5] For plants operating for less than 500 hours per year, the minimum monitoring frequency is once every 1500 operating hours or once every 5 years, whichever comes first.

5.1.3 For newly permitted plants, the operator must carry out the first measurements within 4 months of the permit being granted or the start of the operation, whichever is the later.

5.1.4 To decide whether more frequent monitoring than that set out in Tables 5.2 to 5.5 or continuous monitoring is required, the regulator should take into account:

- the level of risk to local air quality or other sensitive receptors
- variability in operating conditions, for example waste types and feed rate
- absence of secondary dust abatement or reliance on cyclones

In the case of continuous measurements, check the automated measuring systems by making parallel measurements with the relevant reference methods at least once a year. The operator must inform the regulator about the results.

5.1.5 During each measurement, the plant must be operating under stable conditions at a representative even load. In this context, start-up and shut-down periods are excluded.

However, for specified generators in England and Wales, the ELV for NO_X in Table 5.6 must be achieved within 10 minutes for Tranche B generators and 20 minutes for Tranche A generators.

5.1.6 Whether sampling on a continuous or non-continuous basis, take care in the design and location of sampling systems to ensure representative samples for all emissions. This means that:

- sampling points on new plants should be designed to comply with the British or equivalent standards
- the operator should ensure that relevant stacks or ducts are fitted with facilities for sampling that allow compliance with the sampling standards

5.2 Emission limit values

5.2.1 All activities must comply with the emission limits and other provisions in Tables 5.2 to 5.6.

5.2.2 Unless stated otherwise, the emission limit values refer to values of concentration, expressed as mass of emitted substance per volume of waste gas under standard conditions (dry gas at a temperature of 273.15K and a pressure of 101.3 kPa), and expressed in the unit mg/Nm^3. The reference oxygen level of the waste gases is

- vol-% for solid fuels
- 3 vol-% for liquid and gas fuels, other than engines and gas turbines
- 15 vol-% for engines and gas turbines

5.2.3 Unless stated otherwise, the averaging periods associated with the ELVs for emissions to air are defined, for periodic monitoring, as the average over the sampling period (that is the average of a series of 3 consecutive measurements of at least 30 minutes each).

Table 5.2 Emission limit values for emissions to air from boilers and furnaces combusting solid fuels

Substance/ parameter	Emission limit value (mg/Nm^3)	Fuel [1]	Type of plant
Sulphur dioxide (SO_2)	3,000	Coal (indigenous coal)	Existing plants until 31 December 2024
	2,000	Coal (non-indigenous coal)	
	400	All solid fuels (other than biomass)	New plants and existing plants from 1 January 2025
	200	Solid biomass	All plants
Oxides of Nitrogen (NOx)	650 [2]	Coal	Existing plants until 31 December 2024

	650 [2]	All solid fuels (other than biomass)	Existing plants from 1 January 2025
	300		New plants
	250 [3]	Solid biomass	All plants
Dust	300	Coal	Existing plants until 31 December 2024
	50	Solid biomass	
	30	All solid fuels	Existing plants from 1 January 2025
	20		New plants
Carbon monoxide (CO)	No limit [4]	All solid fuels	All plants

[1] Unless stated otherwise, the reference to solid fuels other than biomass includes coal.
[2] For stoker firing furnaces using coal as a fuel, the limit is 450 mg/Nm^3.
[3] For stepped grates, the limit is 300 mg/Nm^3.
[4] No ELV is applied for CO. As an indication, the CO emission level will generally be less than 150 mg/Nm^3.

Table 5.3 Emission limit values for emissions to air from boiler and furnaces combusting liquid fuels

Substance/ parameter	Emission limit value (mg/Nm^3)	Fuel [1]	Type of plant
Sulphur dioxide (SO_2)	Sulphur content of fuel limited to 1% w/w	Heavy fuel oil	Existing plants until 31 December 2024
	350	Liquid fuels other than gas oil	New plants and existing plants from 1 January 2025
	S content of fuel limited to 0.1% w/w	Gas oil	All plants
Oxides of Nitrogen (NOx)	450	Liquid fuels other than gas oil	Existing plants
	300		New plants
	200	Gas oil	All plants
Dust	150	Heavy fuel oil	Existing plants until 31 December 2024
	100	Gas oil	
	30	All liquid fuels	Existing plants from 1January 2025
	20		New plants
Carbon monoxide (CO)	No limit [2]	All liquid fuels	All plants

[1] Unless stated otherwise, reference to liquid fuels other than gas oil shall include heavy fuel oil.
[2] No ELV is applied for CO. As an indication, the CO emission level will generally be less than 150 mg/Nm^3.

Table 5.4 Emission limit values for emissions to air from boilers and furnaces combusting gaseous fuels

Substance/ parameter	Emission limit value (mg/Nm^3)	Fuel	Type of plant
Sulphur dioxide (SO_2)	No limit	Natural gas	All plants
	35 [1, 2]	Gaseous fuels other than natural gas	New plants and existing plants from 1 January 2025
Oxides of Nitrogen (NOx)	140	Natural gas	Existing plants
	100		New plants
	250	Gaseous fuels other than natural gas	Existing plants from 1 January 2025
	200		New plants
Carbon monoxide (CO)	No limit [3]	All gaseous fuels	All plants

[1] The limit for low calorific value gases from coke ovens is 400 mg/Nm^3. The limit for low calorific value gases from blast furnaces is 200 mg/Nm^3.
[2] The limit for biogas is 170 mg/Nm^3 for existing plant and 100 mg/Nm^3 for new plants.
[3] No ELV is applied for CO. As an indication, the CO emission level will generally be less than 100 mg/Nm^3.

Table 5.5 Emission limit values for emissions to air from gas turbines

Substance/ parameter	Emission limit value (mg/Nm^3)	Fuel	Type of plant [4]
Sulphur dioxide (SO_2)	Sulphur content of fuel limited to 0.1% w/w	Gas oil	All plants
	15 [1, 2]	Gaseous fuels other than natural gas	New plants and existing plants from 1 January 2025
	120	Liquid fuels other than gas oil	
Oxides of Nitrogen (NOx)	125	Natural gas	Existing plants in operation prior to 6 October 2004
	60		Existing plants in operation from 6 October 2004
	50		New plants
	165	Liquid fuels or LPG	Existing plants in operation prior to 6 October 2004
	125		Existing plants in operation from 6 October 2004
	75	Liquid fuels and gaseous fuels other than natural gas	New plants
Dust	10	Liquid fuels other than gas oil	New plants and existing plants from 1 January 2025
Carbon monoxide (CO)	No limit	All fuels	Existing plants in operation prior to 6 October 2004

	60 [3]		All plants other than those in operation prior to 6 October 2004

[1] For existing plants, the limit for low calorific value gases from coke ovens is 130 mg/Nm^3 and the limit for low calorific value gases from blast furnaces is 65 mg/Nm^3.
[2] The limit for biogas is 60 mg/Nm^3 for existing plant and 40 mg/Nm^3 for new plant.
[3] The CO limit only applies when the plant is operating above 70% load.
[4] In England and Wales, new plants also include Tranche B generators.

Table 5.6 Emission limit for emissions to air from compression ignition engines

Substance/ parameter	Emission limit value (mg/Nm^3)	Fuel	Type of plant [2]
Sulphur dioxide (SO_2)	Sulphur content of fuel limited to 0.1% w/w	Gas oil	All plants
	120	Liquid fuels other than gas oil	New plants and existing plants from 1 January 2025
Oxides of Nitrogen (NOx)	500 [4]	All liquid fuels	Existing plants until 31 December 2024 [3] All plants operating for less than 500 hours per year
	190 [1, 4]		New plants and existing plants from 1 January 2025
Dust	50	All liquid fuels	Existing plant until 31 December 2024
	10		New plants and existing plants from 1 January 2025
Carbon monoxide (CO)	No limit	All liquid fuels	All plants

[1] For dual fuel engines in liquid mode, the limit is 225 mg/Nm^3.
[2] In England and Wales, new plants also include Tranche B generators.
[3] In England and Wales, plants unable to achieve the 500 mg/Nm^3 will be required to apply for a new permit and achieve 190 mg/Nm^3 no later than 1 October 2019.
[4] In England and Wales, the ELV for NO_X shall be achieved within 10 minutes for Tranche B generators and 20 minutes for Tranche A generators.

5.2.4 Where a boiler or furnace is fired simultaneously with 2 or more fuels (co-firing), use the following formula to calculate the emission limits that apply when the boiler or furnace is being fired this way:

$$Emission = \frac{[MWth\ (fuel\ a) x\ ELV\ (fuel\ a) + MWth\ (fuel\ b) x\ ELV\ (fuel\ b) etc.]}{Total\ thermal\ input\ from\ all\ fuels}$$

The emission limit value is calculated by adding together the emission limit value for each fuel multiplied by the fraction of the total thermal input provided by that fuel.

5.3 Compliance with emission limit values

5.3.1 Carry out compliance monitoring either by a continuous emissions monitors (CEM) or periodic extractive measurements.

5.3.2 Where an operator makes periodic measurements, plants will comply with the emission limit values in tables 5.2 to 5.6 if the results do not exceed the relevant emission limit value.

5.3.3 Where an operator makes continuous measurements on a medium combustion plant, plants will comply with the emission limit values in tables 5.2 to 5.6 if, for the operating hours within a calendar year:

- no validated monthly average value exceeds the relevant emission limit values
- no validated daily average value exceeds 110% of the relevant emission limit values
- in cases of combustion plants composed only of boilers using coal, no validated daily average value exceeds 150% of the relevant emission limit values
- 95% of all the validated hourly average values over the year do not exceed 200% of the relevant emission limit values

To work out the validated hourly and daily average values, subtract the 95% confidence interval from the measured valid hourly average values.

The 95% confidence intervals of a single measured result must not exceed the following percentages of the emission limit values:

- Carbon monoxide 10%
- Sulphur dioxide 20%
- Nitrogen dioxide 20%
- Dust 30%

The regulator considers any day with more than 3 invalid hourly average values (for example, due to malfunction or maintenance of the automated measuring system) to be invalidated. If more than 10 days in a year are invalidated, the regulator will require the operator to improve the reliability of the automated measuring system.

5.4 Other emissions to air

5.4.1 Emission from combustion processes, including gas turbines, should in normal operation, be free from visible smoke.

5.4.2 During start up and shut down, combustion emission of smoke should not exceed the equivalent of Ringelmann Shade 1.

5.4.3 For gas turbines, calibrate a monitor for visible emissions to sound an audible alarm if smoke emissions exceed the equivalent of Shade 1 on the Ringelmann chart. Operators should record when this limit is exceeded.

5.4.4 All other releases to air other than condensed water vapour, including emissions from materials handling operations, should be free from persistent visible emissions.

5.5 Other than normal operating conditions

5.5.1 Higher emissions may occur during start up and shut down of a process. These emissions can be reduced by minimising, where possible, the number of start up and shut downs and having adequate procedures in place for start up, shut down and emergency shut downs.

5.6 Reporting and notifications

5.6.1 Communication between the operator and the regulator is essential for an effectively regulated installation.

5.6.2 Where an operator intends to carry out periodic emissions monitoring, notify the regulator so that they can decide whether to observe the testing.

5.6.3 The operator must submit the results of any periodic emission testing to the regulator within a timescale and format agreed with the regulator.

The operator must report all results of continuous emissions monitoring (including the results of parallel measurements using the relevant reference method) annually, or more frequently if required by the regulator. Submit them within a timescale and format agreed with the regulator.

5.6.4 Where monitoring does not meet the main procedural requirements of the relevant standard, report deviations as well as an estimation of the error involved.

5.6.5 The operator must restore compliance in the shortest possible time, in the event of any:

- non-compliance with any emission limit value
- malfunctions and breakdown of the plant that leads to abnormal operating conditions
- complaints about odour or smoke

To restore compliance, the operator must:

- notify the regulator within 24 hours of receiving the information to agree the investigation of the issue
- undertake the agreed investigation
- adjust the process or activity to minimise those emissions
- if applicable, re-test to demonstrate compliance as soon as possible
- promptly record the events and actions taken
- submit to the regulator the report and updates as agreed

5.6.6 If there are any proposed changes to the plant that could affect the emission limit values, the operator must inform the regulator as soon as they are aware of the changes. This will allow the regulator time to make any assessments necessary to change the permit.