



# EU AQM Guidance 2008/50/EC, 2004/107/EC August, 2019

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# 1. General Information

#### 1.1. EU Directives

This document is quoting and referencing EU regulations and directives. The information has in some cases been shortened or amended. This document should be viewed as a guidance to understand the basics of the EU AQM regulations. OPSIS encourages further reading in the EU directives and regulations to be able to get a more complete understanding.

This document is based on two EU directives and it should be noted that it is the English version of the documents. The EU directives are available in multiple languages and some minor differences in interpretation may occur between the translations.

- 2008/50/EC On ambient air quality and cleaner air for Europe
- 2004/107/EC Relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
- Commission Directive (EU) 2015/1480 Amendments to 2008/50EC and 2004/107/EC

The EU directive 2008/50/EC "...establishes the need to reduce pollution to levels which minimize harmful effects on human health, paying particular attention to sensitive populations, and the environment as a whole, to improve the monitoring and assessment of air quality including the deposition of pollutants and to provide information to the public."

It is important to note that the EU directives and regulations are a minimum requirement for member states. Local regulations and restrictions may be added to the directives and could therefore be more stringent than the EU directive itself. This document is based on the EU directive.

## 1.2. Responsibilities

Member states shall designate at the appropriate levels the competent authorities and bodies responsible for the following:

- a) Assessment of ambient air quality
- b) Approval of measurement systems (methods, equipment, networks and laboratories)
- c) Ensuring the accuracy of measurements
- d) Analysis of assessment methods
- e) Coordination on their territory if community-wide quality assurance programmes are being organised by the European Commission
- f) Cooperation with the other member states and the European Commission

# 2. Criteria Parameters

EU directive 2008/50/EC requires each member state to assess the air quality of sulfur dioxide ( $SO_2$ ), nitrogen dioxide ( $NO_2$ ), ozone ( $O_3$ ), particulate matter in the fractions of  $PM_{10}$  and  $PM_{2.5}$ , lead (Pb), benzene, and carbon monoxide (CO).

EU directive 2004/107/EC requires each member state to assess the air quality of the heavy metals arsenic (Ar), cadmium (Cd), nickel (Ni), and polycyclic aromatic hydrocarbons (PAH) expressed as benzo(a)pyrene.

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#### 2.1. Suitable Measurements and Instrumentation

#### 2.1.1. Objective Estimation

The lowest quality level of measurements/assessments. Objective estimations are mainly used for the initial assessment steps, and if the concentrations are below the lower assessment threshold. These types of estimations are usually made by comparing similar cities, assessing traffic, close emission sources, and/or with the help of the nomogram method.

#### 2.1.2. Modelling

The second lowest quality of measurements/assessments. Modelling can be made with software containing local emission sources, traffic conditions, meteorological data etc. The model is usually compared with data from either indicative measurements and/or fixed measurement stations in the area. Modelling is effectively a simulation made in a computer program to assess the air quality.

#### 2.1.3. Indicative Measurements

The second highest quality of measurements. Indicative measurements are lower tier measurement methods which do not have the same criteria as fixed measurements as they are made by analysis with a lower data capture, time coverage and a higher uncertainty of the measurements. These measurements are usually made with desorption tubes and/or similar simpler methods.

#### 2.1.4. Fixed Measurements

The highest quality of measurements. Fixed measurements, also called continuous measurements, are performed with approved analysers of the reference standards for the compounds or approved analysers that are equivalent to the reference methods. The highest demands on data capture, time coverage and the lowest uncertainty of the measurements.

## 2.2. Reference Methods and Equivalent Methods

For fixed measurements, either reference methods or methods proven equivalent to the reference methods can be used. The reference method for each parameter can be found in 2008/50/EC ANNEX VI and 2004/107/EC ANNEX V.

To get a method equivalent to the reference method, the manufacturer has to go through a rigorous parallel measurement campaign and other tests described in the report "Guide to the demonstration of equivalence of ambient air monitoring methods", in short called "Guidance for the demonstration of Equivalence" or just "GDE". Each member state reference laboratory has to approve the use of the equivalent instrument, usually by accepting a test performed at a certified test institute such as e.g. TÜV or MCERTS. A member state's reference laboratory can also perform GDE tests on their own, to prove equivalence.

URLs for equivalent methods:

TÜV - https://gal1.de/en/komponenten.htm

MCERTS - https://www.csagroupuk.org/services/mcerts/mcerts-product-certification/mcerts-certified-products/

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# 3. Thresholds and Limit Values

## 3.1. Limit Values (Protection of Human Health)

Humans can be adversely affected by exposure to air pollutants in ambient air. In response, the European Union has developed an extensive body of legislation which establishes health-based concentration standards and objectives for a number of pollutants present in the air. These standards and objectives are summarised in the table below. These apply over differing periods of time because the observed health impacts associated with the various pollutants occur over different exposure times.

#### **LIMIT VALUES**

Pollutant	Conc.	Averaging period	Permitted exceedances per year
Sulfur dioxide (SO <sub>2</sub> )	350 µg/m³	1 hour	24
	125 μg/m³	24 hours	3
Nitrogen dioxide (NO <sub>2</sub> )	200 μg/m <sup>3</sup>	1 hour	18
	40 μg/m <sup>3</sup>	1 year	n/a
O <sub>3</sub>	120 μg/m <sup>3**</sup>	Max daily 8h mean	25 days averaged over 3 years
PM <sub>10</sub>	50 μg/m <sup>3</sup>	24 hours	35
	40 μg/m <sup>3</sup>	1 year	n/a
PM <sub>2.5</sub> *	25 μg/m³	1 year	n/a
Benzene	5 μg/m <sup>3</sup>	1 year	n/a
CO	10 μg/m <sup>3</sup>	Max daily 8h mean	n/a
Lead (Pb)	0.5 μg/m <sup>3</sup>	1 year	n/a
Arsenic (As)	6 ng/m³	1 year	n/a
Cadmium (Cd)	5 ng/m³	1 year	n/a
Nickel (Ni)	20 ng/m <sup>3</sup>	1 year	n/a
PAH (Expressed as Benzo(a)pyrene)	1 ng/m³	1 year	n/a

<sup>\*</sup> Special regulations on national level applies, more information can be found in 2008/50/EC.

# 3.2. Lower and Upper Assessment Thresholds

Both the lower and the upper assessment thresholds, as well as the population in a zone or agglomeration, decide the number of measurement sites, and which parameters as well as which method should be used for the measurements.

The lower and the upper assessment thresholds are based on the limit values shown in the table above. The average concentration of a parameter will decide which method should be used for the measurements as well as how many measurement sites that are required for the zone/agglomeration.

Exceedances of upper and lower assessment thresholds shall be determined on the basis of concentrations during the previous five years where sufficient data is available. An assessment threshold shall be deemed to have been exceeded if it has been exceeded during at least three separate years out of those previous five years. When a member state cannot present five years of continuous data, other options are available, further information can be found in 2008/50/EC.

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<sup>\*\*</sup> Target value.

# THRESHOLDS – HUMAN HEALTH UPPER ASSESSMENT THRESHOLD (UAT), LOWER ASSESSMENT THRESHOLD (LAT)

Pollutant	Conc.	Averaging period	Exceedances per year
Sulfur dioxide (SO <sub>2</sub> ) (UAT)	75 μg/m³	24 hours	3
Sulfur dioxide (SO <sub>2</sub> ) (LAT)	50 μg/m <sup>3</sup>	24 hours	3
Nitrogen dioxide (NO2) (UAT)	140 μg/m <sup>3</sup>	1 hour	18
Nitrogen dioxide (NO2) (UAT)	32 μg/m³	1 year	n/a
Nitrogen dioxide (NO2) (LAT)	100 μg/m <sup>3</sup>	1 hour	18
Nitrogen dioxide (NO2) (LAT)	26 μg/m³	1 year	n/a
PM <sub>10</sub> (UAT)	35 μg/m³	24 hours	35
PM <sub>10</sub> (UAT)	28 μg/m³	1 year	n/a
PM <sub>10</sub> (LAT)	25 μg/m³	24 hours	35
PM <sub>10</sub> (LAT)	20 μg/m³	1 year	n/a
PM <sub>2.5</sub> (UAT)	17 μg/m³	1 year	n/a
PM <sub>2.5</sub> (LAT)	12 μg/m³	1 year	n/a
Benzene (UAT)	3.5 µg/m³	1 year	n/a
Benzene (LAT)	2 μg/m³	1 year	n/a
CO (UAT)	7 μg/m³	Max daily 8h mean	n/a
CO (LAT)	5 μg/m³	Max daily 8h mean	n/a
Lead (Pb) (UAT)	0.35 µg/m³	1 year	n/a
Lead (Pb) (LAT)	0.25 μg/m <sup>3</sup>	1 year	n/a
Arsenic (As) (UAT)	3.6 ng/m <sup>3</sup>	1 year	n/a
Arsenic (As) (LAT)	2.4 ng/m <sup>3</sup>	1 year	n/a
Cadmium (Cd) (UAT)	3 ng/m³	1 year	n/a
Cadmium (Cd) (LAT)	2 ng/m³	1 year	n/a
Nickel (Ni) (UAT)	14 ng/m³	1 year	n/a
Nickel (Ni) (LAT)	10 ng/m <sup>3</sup>	1 year	n/a
PAH (Expressed as Benzo(a)pyrene) (UAT)	0.6 ng/m <sup>3</sup>	1 year	n/a
PAH (Expressed as Benzo(a)pyrene) (LAT)	0.4 ng/m <sup>3</sup>	1 year	n/a

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# 3.3. Required Number of Monitoring Stations

There are two thresholds described in 2008/50/EC. The thresholds determine the amount of measurement stations needed in an agglomeration or zone, as well as to determine which measurement method and/or which assessment level applies. Below is a chart from 2008/50/EC that shows how many measurement stations that are required for each parameter.

#### **REQUIRED NUMBER OF STATIONS**

Population of agglomeration or zone	If maximum concentrati	ions exceed the upper	the upper If maximum concentrations are between the upper and lower assessment thresholds		
(thousands)	Pollutants except PM PM (sum of PM <sub>10</sub> and PM <sub>2.5</sub> )		Pollutants except PM	PM (sum of PM <sub>10</sub> and PM <sub>2.5</sub> )	
0–249	1	2	1	1	
250–499	2	3	1	2	
500-749	2	3	1	2	
750–999	3	4	1	2	
1 000–1 499	4	6	2	3	
1 500–1 999	5	7	2	3	
2 000–2 749	6	8	3	4	
2 750–3 749	7	10	3	4	
3 750–4 749	8	11	3	6	
4 750–5 999	9	13	4	6	
≥ 6 000	10	15	4	7	

#### Example:

A member state has a zone with a population of 550 000 in which nitrogen dioxide measurements were performed over the course of five years. Four out of the five years have more than 18 hourly average concentrations higher than 100  $\mu g/m^3$ , but in all cases lower than 140  $\mu g/m^3$  This means that the zone has to have at least one fixed measuring station for nitrogen dioxide.

#### 3.4. Ozone

There are separate criteria for the assessment of ozone concentrations since ozone is considered a transboundary parameter and a secondary pollutant. Instead of a limit value not to be exceeded, the directive states a target value and long-term objectives that should be obtained where possible. Fixed measurements are mandatory in zones or agglomerations where the long-term objectives for ozone or the assessment thresholds for other pollutants are exceeded. Information from fixed measurements may be supplemented by modelling and/or indicative measurements. By using supplementary techniques of assessment, a reduction of fixed monitoring stations may be allowed.

Ozone measurements are presented in a slightly different way than the other criteria parameters. Mainly different eight-hour means are used for protection of human health but for protection of vegetation, an exposure index called AOT40 is used instead. The AOT40 index shows concentrations higher than  $80 \, \mu g/m^3$  during the growing season and it is designed as a target value that should be obtained by the member states.

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## **REQUIRED NUMBER OF STATIONS**

Population of agglomeration or zone (thousands)	Agglomerations (urban and suburban)*	Other zones (suburban and rural)*	Rural background	
< 250		1		
< 500	1	2		
< 1 000	2	2		
< 1 500	3	3	1 station /50 000 km² as an	
< 2 000	3	4	average density over all zones	
< 2 750	4	5	per country**	
< 3 750	5	6		
> 3 750	One additional station per 2 million inhabitants	One additional station per 2 million inhabitants		

<sup>\*</sup> At least one station in suburban areas, where the highest exposure of the population is likely to occur. In agglomerations, at least 50% of the stations shall be located in suburban areas.

## **TARGET VALUES**

Objective	Averaging period	Target value	
Protection of human health	Maximum daily eight-hour mean	120 µg/m³ not to be exceeded on more than 25 days per calendar year averaged over three years	
		AOT40* (calculated from 1 h values) 18 000 μg/m³ x h averaged over five years	

<sup>\*</sup> Additional information can be found in 2008/50/EC ANNEX VII

## **LONG-TERM OBJECTIVES**

Objective	Averaging period	Long-term objective
Protection of human health	Maximum daily eight-hour mean	120 μg/m³
Protection of vegetation	May to July	AOT40* (calculated from 1 h values) 6 000 μg/m³ x h

<sup>\*</sup> Additional information can be found in 2008/50/EC ANNEX VII

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<sup>\*\* 1</sup> station per 25 000 km² for complex terrain is recommended.

# 4. Data Quality Objectives

The data quality objectives table describes the different data quality needed for the different measurement types described in the "suitable measurement and instrumentation" chapter.

#### **DATA QUALITY OBJECTIVES**

	SO <sub>2</sub> , NO <sub>2</sub> , CO	Benzene	PM <sub>10</sub> , PM <sub>2.5</sub> , Pb	As, Cd, Ni	Benzo(a)pyrene	03
Fixed measurements						
Minimum time coverage	100%	100%	35/90%*	50%	33%	100%
Minimum data capture	90%	90%	90%	90%	90%	90%/75%**
Uncertainty	15%	25%	25%	40%	50%	15%
Indicative measurements						
Minimum time coverage	14%	14%	14%	14%	14%	>10% during summer
Minimum data capture	90%	90%	90%	90%	90%	90%
Uncertainty	25%	50%	30%	40%	50%	30%
Modelling uncertainty						
Hourly	50%	N/A	N/A	N/A	N/A	50%
Eight-hour avg.	50%	N/A	N/A	N/A	N/A	50%
Daily avg.	50%	Undef.	N/A	N/A	N/A	N/A
Annual avg.	30%	50%	50%	60%	60%	N/A
Objective estimation						
Uncertainty	75%	100%	100%	100%	100%	75%

<sup>\* 35%</sup> time coverage for urban background and traffic stations, 90% for industrial stations.

# 5. QA/QC, Data Collection and Reporting

2008/50/EC states that each member state have to have an accredited reference laboratory according to ISO/IEC 17025 to ensure that all ambient measurements performed are traceable.

Institutions that operate networks or individual stations have to have a quality assurance and quality control (QA/QC) program which assures regular maintenance and accuracy of the measuring devices used. The QA/QC should also include the data collection, validation, and reporting to the competent authorities.

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<sup>\*\* 90%</sup> during summer and 75% during winter.

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