

ANNEX I

DEFINITIONS, TARGET VALUES AND LONG-TERM OBJECTIVES FOR OZONE

I. Definitions

All values are to be expressed in $\mu\text{g}/\text{m}^3$. The volume must be standardised at the following conditions of temperature and pressure: 293 K and 101,3 kPa. The time is to be specified in Central European Time.

AOT40 (expressed in $(\mu\text{g}/\text{m}^3)\cdot\text{hours}$) means the sum of the difference between hourly concentrations greater than $80 \mu\text{g}/\text{m}^3$ (≈ 40 parts per billion) and $80 \mu\text{g}/\text{m}^3$ over a given period using only the 1 hour values measured between 8:00 and 20:00, Central European Time each day⁽¹⁾.

In order to be valid, the annual data on exceedances used to check compliance with the target values and long-term objectives below must meet the criteria laid down in Section II of Annex III.

II. Target values for ozone

	Parameter	Target value for 2010 (a) ⁽¹⁾
1. Target value for the protection of human health	Maximum daily 8-hour mean (b)	120 $\mu\text{g}/\text{m}^3$ not to be exceeded on more than 25 days per calendar year averaged over three years (c)
2. Target value for the protection of vegetation	AOT40, calculated from 1 h values from May to July	18 000 $\mu\text{g}/\text{m}^3\cdot\text{h}$ averaged over five years (c)

(a) Compliance with target values will be assessed as of this value. That is, 2010 will be the first year the data for which is used in calculating compliance over the following three or five years, as appropriate.

(b) The maximum daily 8-hour mean concentration shall be selected by examining 8-hour running averages, calculated from hourly data and updated each hour. Each 8-hour average so calculated shall be assigned to the day on which it ends, i.e. the first calculation period for any one day will be the period from 17:00 on the previous day to 01:00 on that day; the last calculation period for any one day will be the period from 16:00 to 24:00 on the day.

(c) If the three or five year averages cannot be determined on the basis of a full and consecutive set of annual data, the minimum annual data required for checking compliance with the target values will be as follows:

— for the target value for the protection of human health: valid data for one year,

— for the target value for the protection of vegetation: valid data for three years.

⁽¹⁾ These target values and permitted exceedance are set without prejudice to the results of the studies and of the review, provided for in Article 11, which will take account of the different geographical and climatic situations in the European Community.

III. Long-term objectives for ozone

	Parameter	Long-term objective (a)
1. Long-term objective for the protection of human health	Maximum daily 8-hour mean within a calendar year	120 $\mu\text{g}/\text{m}^3$
2. Long-term objective for the protection of vegetation	AOT40, calculated from 1 h values from May to July	6 000 $\mu\text{g}/\text{m}^3\cdot\text{h}$

⁽¹⁾ Or the appropriate time for ultra-peripheral regions.

ANNEX II

INFORMATION AND ALERT THRESHOLDS

I. Information and alert thresholds for ozone

	Parameter	Threshold
Information threshold	1 hour average	180 $\mu\text{g}/\text{m}^3$
Alert threshold	1 hour average (a)	240 $\mu\text{g}/\text{m}^3$

(a) For the implementation of Article 7, the exceedance of the threshold is to be measured or predicted for three consecutive hours.

II. Minimum details to be supplied to the public when the information or alert threshold is exceeded or exceedance is predicted

Details to be supplied to the public on a sufficiently large scale as soon as possible should include:

1. information on observed exceedance(s):
 - location or area of the exceedance,
 - type of threshold exceeded (information or alert),
 - start time and duration of the exceedance,
 - highest 1-hour and 8-hour mean concentration;
2. forecast for the following afternoon/day(s):
 - geographical area of expected exceedances of information and/or alert threshold,
 - expected change in pollution (improvement, stabilisation or deterioration);
3. information on type of population concerned, possible health effects and recommended conduct:
 - information on population groups at risk,
 - description of likely symptoms,
 - recommended precautions to be taken by the population concerned,
 - where to find further information;
4. information on preventive action to reduce pollution and/or exposure to it:
 - indication of main source sectors; recommendations for action to reduce emissions.

Information submitted by Member States to the Commission and criteria for aggregating data and calculating statistical parameters

1. Information to be submitted to the Commission

The following table stipulates the type and amount of data Member States are to submit to the Commission:

	Type of station	Level	Averaging/ accumulation time	Provisional data for each month from April to September	Report for each year
Information threshold	Any	180 µg/m ³	1 hour	— for each day with exceedance(s): date, total hours of exceedance, maximum 1 hour ozone and related NO ₂ values when required, — monthly 1 hour maximum ozone	— for each day with exceedance(s): date, total hours of exceedance, maximum 1 hour ozone and related NO ₂ values when required
Alert threshold	Any	240 µg/m ³	1 hour	— for each day with exceedance(s): date, total hours of exceedance, maximum 1 hour ozone and related NO ₂ values when required	— for each day with exceedance(s): date, total hours of exceedance, maximum 1 hour ozone and related NO ₂ values when required
Health protection	Any	120 µg/m ³	8 hours	— for each day with exceedance(s): date, 8 hours maximum (b)	— for each day with exceedance(s): date, 8 hours maximum (b)
Vegetation protection	Suburban, rural, rural background	AOT40 (a) = 6 000 µg/m ² ·h	1 hour, accumulated from May to July	—	Value
Forest protection	Suburban, rural, rural background	AOT40 (a) = 20 000 µg/m ² ·h	1 hour, accumulated from April to September	—	Value
Materials	Any	40 µg/m ³ (c)	1 year	—	Value

(a) See definition of AOT40 in Section 1 of Annex I.

(b) Maximum daily 8-hour mean (see section II of Annex I note (a)).

(c) Value to be reviewed, pursuant to Article 11(3), in the light of developing scientific knowledge.

As part of the yearly reporting, the following must also be provided, if all available hourly data for ozone, nitrogen dioxide and nitrogen oxides of the year in question have not already been delivered under the framework of Council Decision 97/101/EC (1):

- for ozone, nitrogen dioxide, nitrogen oxides and the sums of ozone and nitrogen dioxide (added as parts per billion and expressed in µg/m³ ozone) the maximum, 99.9th, 98th, 50th percentile and annual average and number of valid data from hourly series,
- the maximum, 98th, 50th percentile and annual average from series of daily 8-hour ozone maxima.

Data submitted in the monthly reports are considered provisional and are to be updated, if necessary, in subsequent submissions.

(1) OJ L 35, 5.2.1997, p. 14.

II. Criteria for aggregating data and calculating statistical parameters

Percentiles are to be calculated using the method specified in Council Decision 97/101/EC.

The following criteria are to be used for checking validity when aggregating data and calculating statistical parameters:

Parameter	Required proportion of valid data
1 hour values	75 % (i.e. 45 minutes)
8 hours values	75 % of values (i.e. 6 hours)
Maximum daily 8 hours mean from hourly running 8 hours averages	75 % of the hourly running 8 hours averages (i.e. 18 8 hours averages per day)
AOT40	90 % of the 1 hour values over the time period defined for calculating the AOT40 value (a)
Annual mean	75 % of the 1 hour values over summer (April to September) and winter (January to March, October to December) seasons separately
Number of exceedances and maximum values per month	90 % of the daily maximum 8 hours mean values (27 available daily values per month) 90 % of the 1 hour values between 8:00 and 20:00 Central European Time
Number of exceedances and maximum values per year	five out of six months over the summer season (April to September)

(a) In cases where all possible measured data are not available, the following factor shall be used to calculate AOT40 values:

$$AOT40 \text{ [estimate]} = AOT40_{\text{measured}} \times \frac{\text{total possible number of hours}^*}{\text{number of measured hourly values}}$$

* being the number of hours within the time period of AOT40 definition, (i.e. 08:00 to 20:00 h CET from 1 May to 31 July each year, for vegetation protection and from 1 April to 30 September each year for forest protection).

ANNEX IV

CRITERIA FOR CLASSIFYING AND LOCATING SAMPLING POINTS FOR ASSESSMENTS OF OZONE CONCENTRATIONS

The following considerations apply to fixed measurements:

I. Macroscale siting

Type of station	Objectives of measurement	Representativeness (a)	Macroscale siting criteria
Urban	Protection of human health: to assess the exposure of the urban population to ozone, i.e. where population density and ozone concentration are relatively high and representative of the exposure of the general population	A few km ²	Away from the influence of local emissions such as traffic, petrol stations, etc.; Vented locations where well mixed levels can be measured; Locations such as residential and commercial areas of cities, parks (away from the trees), big streets or squares with very little or no traffic, open areas characteristic of educational, sports or recreation facilities
Suburban	Protection of human health and vegetation: to assess the exposure of the population and vegetation located in the outskirts of the agglomeration, where the highest ozone levels, to which the population and vegetation is likely to be directly or indirectly exposed, occur	Some tens of km ²	At a certain distance from the area of maximum emissions, downwind following the main wind direction/directions during conditions favourable to ozone formation; Where population, sensitive crops or natural ecosystems located in the outer fringe of an agglomeration are exposed to high ozone levels; Where appropriate, some suburban stations also upwind of the area of maximum emissions, in order to determine the regional background levels of ozone
Rural	Protection of human health and vegetation: to assess the exposure of population, crops and natural ecosystems to sub-regional scale ozone concentrations	Sub-regional levels (a few km ²)	Stations can be located in small settlements and/or areas with natural ecosystems, forests or crops; Representative for ozone away from the influence of immediate local emissions such as industrial installations and roads; At open area sites, but not on higher mountain-tops
Rural background	Protection of vegetation and human health: to assess the exposure of crops and natural ecosystems to regional-scale ozone concentrations as well as exposure of the population	Regional/national/continental levels (1 000 to 10 000 km ²)	Station located in areas with lower population density, e.g. with natural ecosystems, forests, far removed from urban and industrial areas and away from local emissions; Avoid locations which are subject to locally enhanced formation of ground-near inversion conditions, also summits of higher mountains; Coastal sites with pronounced diurnal wind cycles of local character are not recommended.

(a) Sampling points should also, where possible, be representative of similar locations not in their immediate vicinity.

For rural and rural background stations, consideration should be given, where appropriate, to coordination with the monitoring requirements of Commission Regulation (EC) No 1091/94 ⁽¹⁾ concerning protection of the Community's forests against atmospheric pollution.

⁽¹⁾ OJ L 125, 18.5.1994, p. 1.

II. Microscale siting

The following guidelines should be followed, as far as practicable:

1. The flow around the inlet sampling probe should be unrestricted (free in an arc of at least 270°) without any obstructions affecting the air flow in the vicinity of the sampler, i.e. away from buildings, balconies, trees and other obstacles by more than twice the height the obstacle protrudes above the sampler.
2. In general, the inlet sampling point should be between 1.5 m (the breathing zone) and 4 m above the ground. Higher positions are possible for urban stations in some circumstances and in wooded areas.
3. The inlet probe should be positioned well away from such sources as furnaces and incineration flues and more than 10 m from the nearest road, with distance increasing as a function of traffic intensity.
4. The sampler's exhaust outlet should be positioned so as to avoid recirculation of exhaust air to the sampler inlet.

The following factors may also be taken into account:

1. interfering sources;
2. security;
3. access;
4. availability of electrical power and telephone communications;
5. visibility of the site in relation to its surroundings;
6. safety of public and operators;
7. the desirability of colocating sampling points for different pollutants;
8. planning requirements.

III. Documentation and review of site selection

Site selection procedures should be fully documented at the classification stage by such means as compass point photographs of the surroundings and a detailed map. Sites should be reviewed at regular intervals with repeated documentation to ensure that selection criteria are still being met.

This requires proper screening and interpretation of the monitoring data in the context of the meteorological and photochemical processes affecting the ozone concentrations measured at the respective site.

ANNEX V

CRITERIA FOR DETERMINING THE MINIMUM NUMBER OF SAMPLING POINTS FOR FIXED MEASUREMENT OF CONCENTRATIONS OF OZONE

- I. Minimum number of sampling points for fixed continuous measurements to assess air quality in view of compliance with the target values, long-term objectives and information and alert thresholds where continuous measurement is the sole source of information

Population (x 1 000)	Agglomerations (urban and suburban) (a)	Other zones (suburban and rural) (a)	Rural background
< 250		1	1 station/50 000 km ² as an average density over all zones per country (b)
< 500	1	2	
< 1 000	2	2	
< 1 500	3	3	
< 2 000	3	4	
< 2 750	4	5	
< 3 750	5	6	
> 3 750	1 additional station per 2 million inhabitants	1 additional station per 2 million inhabitants	

- (a) At least 1 station in suburban areas, where the highest exposure of the population is likely to occur. In agglomerations at least 50 % of the stations should be located in suburban areas.
 (b) 1 station per 25 000 km² for complex terrain is recommended.

- II. Minimum number of sampling points for fixed measurements for zones and agglomerations attaining the long-term objectives

The number of sampling points for ozone must, in combination with other means of supplementary assessment such as air quality modelling and colocated nitrogen dioxide measurements, be sufficient to examine the trend of ozone pollution and check compliance with the long-term objectives. The number of stations located in agglomerations and other zones may be reduced to one-third of the number specified in Section I. Where information from fixed measurement stations is the sole source of information, at least one monitoring station should be kept. If, in zones where there is supplementary assessment, the result of this is that a zone has no remaining station, coordination with the number of stations in neighbouring zones must ensure adequate assessment of ozone concentrations against long-term objectives. The number of rural background stations should be 1 per 100 000 km².

ANNEX VI

MEASUREMENTS OF OZONE PRECURSOR SUBSTANCES

Objectives

The main objectives of such measurements are to analyse any trend in ozone precursors, to check the efficiency of emission reduction strategies, to check the consistency of emission inventories and to help attribute emission sources to pollution concentration.

An additional aim is to support the understanding of ozone formation and precursor dispersion processes, as well as the application of photochemical models.

Substances

Measurement of ozone precursor substances must include at least nitrogen oxides, and appropriate volatile organic compounds (VOC). A list of volatile organic compounds recommended for measurement is given below.

Ethane	1-Butene	Isoprene	Ethyl benzene
Ethylene	trans-2-Butene	n-Hexane	m+p-Xylene
Acetylene	cis-2-Butene	i-Hexane	o-Xylene
Propane	1,3-Butadiene	n-Heptane	1,2,4-Trimeth. benzene
Propene	n-Pentane	n-Octane	1,2,3-Trimeth. benzene
n-Butane	i-Pentane	i-Octane	1,3,5-Trimeth. benzene
i-Butane	1-Pentene	Benzene	Formaldehyde
	2-Pentene	Toluene	Total non-methane hydrocarbons

Reference methods

The reference method specified in Legal Notice 224/2001⁽¹⁾ or in subsequent legislation will apply for nitrogen oxides.

Siting

Measurements should be taken in particular in urban and suburban areas at any monitoring site set up in accordance with the requirements of Legal Notice 216/2001⁽²⁾ and considered appropriate with regard to the above monitoring objectives.

⁽¹⁾ Limit Values for Nitrogen Dioxide, Sulphur Dioxide and Oxides of Nitrogen, Particulate Matter and Lead in Ambient Air Regulations, 2001.

⁽²⁾ Ambient Air Quality Assessment and Management Regulations, 2001.

ANNEX VII

DATA QUALITY OBJECTIVES AND COMPILATION OF THE RESULTS OF AIR QUALITY ASSESSMENT

I. Data quality objectives

The following data quality objectives, for allowed uncertainty of assessment methods, and of minimum time coverage and of data capture of measurement are provided to guide quality-assurance programmes.

	For ozone, NO and NO ₂
Continuous fixed measurement	
Uncertainty of individual measurements	15 %
Minimum data capture	90 % during summer 75 % during winter
Indicative measurement	
Uncertainty of individual measurements	30 %
Minimum data capture	90 %
Minimum time coverage	> 10 % during summer
Modelling	
Uncertainty	
1 hour averages (daytime)	50 %
8 hours daily maximum	50 %
Objective estimation	
Uncertainty	75 %

The uncertainty (on a 95 % confidence interval) of the measurement methods will be evaluated in accordance with the principles of the ISO 'Guide to the Expression of Uncertainty in Measurement' (1993), or the methodology of ISO 5725-1 'Accuracy (trueness and precision) of measurement methods and results' (1994) or equivalent. The percentages for uncertainty in the table are given for individual measurements, averaged over the period for calculating target values and long-term objectives, for a 95 % confidence interval. The uncertainty for continuous fixed measurements should be interpreted as being applicable in the region of the concentration used for the appropriate threshold.

The uncertainty for modelling and objective estimation is defined as the maximum deviation of the measured and calculated concentration levels, over the period for calculating the appropriate threshold, without taking into account the timing of the events.

'Time coverage' is defined as the percentage of the time considered for setting the threshold value during which the pollutant is measured.

'Data capture' is defined as the ratio of the time for which the instrument produces valid data, to the time for which the statistical parameter or aggregated value is to be calculated.

The requirements for minimum data capture and time coverage do not include losses of data due to the regular calibration or normal maintenance of the instrumentation.

II. Results of air quality assessment

The following information should be compiled for zones or agglomerations within which sources other than measurement are employed to supplement information from measurement:

- a description of the assessment activities carried out,
- specific methods used, with references to descriptions of the method,

- sources of data and information,
- a description of results, including uncertainties and, in particular, the extent of any area within the zone or agglomeration over which concentrations exceed long-term objectives or target values,
- for long-term objectives or target values whose object is the protection of human health, the population potentially exposed to concentrations in excess of the threshold.

Where possible, Member States should compile maps showing concentration distributions within each zone and agglomeration.

III. Standardisation

For ozone the volume must be standardised at the following conditions of temperature and pressure: 293 K, 101,3kPa. For nitrogen oxides the standardisation specified in LN 224/2001 ⁽¹⁾ will apply.

ANNEX VIII

REFERENCE METHOD FOR ANALYSIS OF OZONE AND CALIBRATION OF OZONE INSTRUMENTS

I. Reference method for analysis of ozone and calibration of ozone instruments

- Analysis method: UV photometric method (ISO FDIS 13964),
- Calibration method: Reference UV photometer (ISO FDIS 13964, VDI 2468, B1.6).

This method is being standardised by the European Committee for Standardisation (CEN). Once the latter has published the relevant standard, the method and techniques described therein will constitute the reference and calibration method in this Directive.

The Competent Authority may also use any other method which it can demonstrate gives results equivalent to the above method.

II. Reference modelling technique for ozone

Reference modelling techniques cannot be specified at present. Any amendments to adapt this point to scientific and technical progress will be adopted in accordance with the procedure laid down in Article 13(2).

¹ Limit Values for Nitrogen Dioxide, Sulphur Dioxide and Oxides of Nitrogen, Particulate Matter and Lead in Ambient Air Regulations, 2001.