Guidance on the

Commission Implementing Decision laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air
(Decision 2011/850/EU)

Version of 15 July 2013

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Purpose

The Commission implementing decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (2011/850/EU) (also known as IPR, the acronym for Implementing Provisions on Reporting) establishes rules regarding the Member States' obligations to report on the assessment and management of ambient air quality as well as the reciprocal exchange of information. This document gives detailed guidance and recommendations to those responsible for the air quality data reporting.

This document provides guidance on the requirements of those aspects of Annex I and Annex II of Decision 2011/850/EU where a need has been identified in contacts with Member States. For Annex II, there is moreover detailed guidance on completion of the schemata for the electronic submission of the data flows listed in Annex II of the IPR decision.

The main focus of this guidance is on reporting; for more information on the assessment of ambient air quality please see the Guidance on Assessment under the EU Air Quality Directives on the following link:

http://ec.europa.eu/environment/air/pdf/guidanceunderairquality.pdf

INDEX

Introduction

(A) Summary of relevant legal provisions

The EU Ambient Air Quality legislation consists of Directive 2008/50/EC and Directive 2004/107/EC.

Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe (AAQD) entered into force on 11 June 2008. It:

- Merged the previous framework and Daughter Directives (except for the Fourth Daughter Directive) into a single directive with no change to existing air quality objectives (e.g. daily limit value for PM_{10} of 50µg/m³ not to be exceeded more than 35 times a calendar year; annual limit value for PM_{10} of 40µg/m³; hourly limit value for NO_2 of 200µg/m³ not to be exceeded more than 18 times a calendar year, annual limit value for NO_2 of 40µg/m³ etc);
- Set new air quality objectives for $PM_{2.5}$ (fine particles) including a limit value and exposure related objectives i.e. the exposure concentration obligation and the exposure reduction target;
- Created the possibility for time extensions of three years (PM_{10}) or up to five years (NO_2, benzene) for complying with limit values, provided certain conditions are met; the European Commission assesses whether the conditions are met and raises objections if not.

Directive 2004/107/EC (also known as "the Fourth Daughter Directive") is related to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

Both directives lay down provisions for obtaining information on ambient air quality that support monitoring long-term trends and ensure that such information is made available to the public. Also, both provide that the kind of information and the timescales on which such information is to be made available by Member States (MS) are to be further defined through implementing measures.

Directive 2008/50/EC (Art. 27(3)) states that the provisions for the transmission of information and reporting should apply to information collected as from the beginning of the second calendar year after the entry into force of the implementing provisions, i.e. 1 January 2014. For reasons of consistency and simplification the application date of the implementing provisions should be the same for the pollutants listed in Directive 2004/107/EC. It also provides that Decision 97/101/EC (the Exchange of Information Decision, or EoI Decision) is to be repealed, also with effect from the beginning of the second calendar year following the entry into force of the implementing measures on transmission of information and reporting. Consequently, AirBase which is the air quality information system maintained by the EEA through the European topic centre on Air and Climate Change that contains air quality data delivered annually under 97/101/EC (EoI Decision) will cease to exist. However historical data will migrate to the new system provisionally called AIRBASE+.

Decision 2011/850/EU, known as the IPR Decision, applies from 1 January 2014. In other words, it will apply to air quality information collected by Member States as of January 2013 to be reported in 2014. The Decision repeals Commission implementing Decisions 2004/461/EC and 2004/224/EC as of 1 January 2014. The present guidance will also replace the Guidance on the Annexes to the Decision 97/101/EC on Exchange of Information.

The portal mentioned in Article 3 of 2011/850/EC is also an important source of information. The website is:
http://www.eionet.europa.eu/aqportal

While drafting the current document it was assumed that the reader is familiar with the air quality directives and the implementing Decision mentioned above, which are all available at http://ec.europa.eu/environment/air/index_en.htm.

The code lists presented in this guidance are managed externally by the EEA at http://dd.eionet.europa.eu/vocabularies/aq . The code lists may change in the future and so it is recommended to check the above mentioned portal for updated information.

(B) Overall time line for reporting under Decision 2011/850/EU

Legal reference:

Decision 2011/850/EU sets out the various reporting timelines for particular datasets in Articles 6, 7, 8, 10 and 13.

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A visual representation of the reporting timing for the various datasets is presented in Figure 1

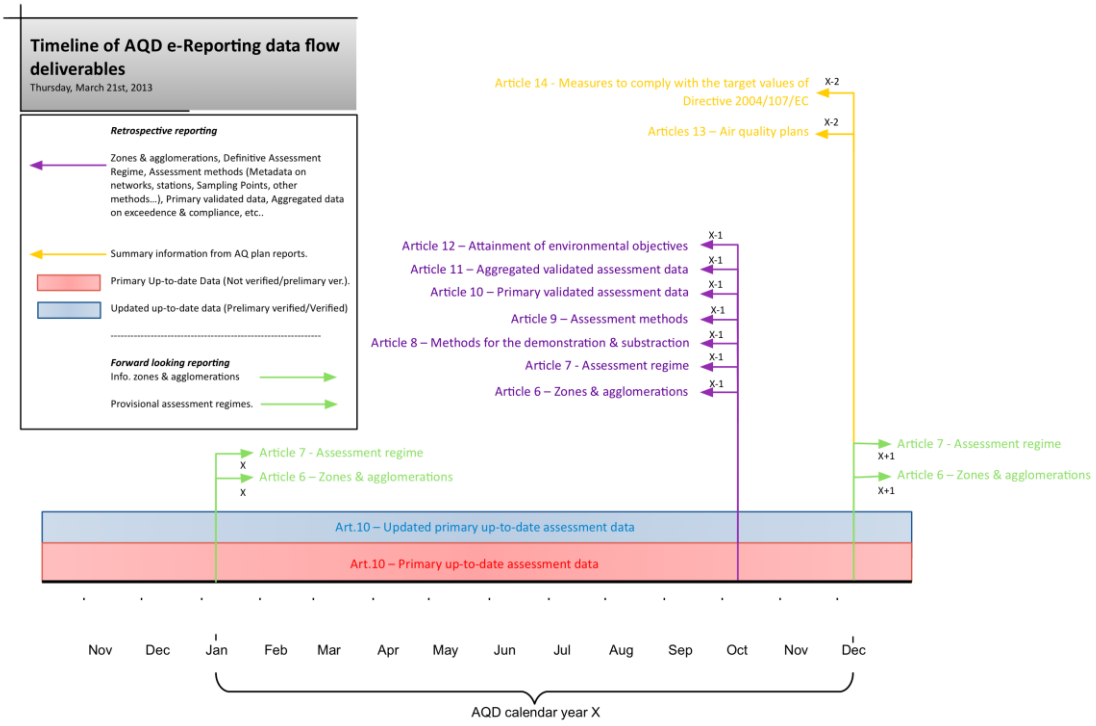

Figure 1 Timeline for Air Quality Directives reporting data flows relative to obligations presented in the Decision 2011/850/EU.

Part I

ANNEX I OF DECISION 2011/850/EU

(A) Data requirements

(1) Reporting of time

Legal reference:

Decision 2011/850/EU - ANNEX I - (A) Data requirements specifies in (1) Reporting of time:
"All time references shall be made available in accordance with the ISO standard 8601:2004(E) using the extended format (YYYY-MM-DDThh:mm:ss±hh:mm) that includes the information on difference from UTC (Coordinated Universal Time). The time stamp refers to the end of the measurement period."

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Purpose and origin of the selected time reference format

In the past, misinterpretations of time references have led to different results when these values were placed within a database and aggregated. This was mainly caused by a lack of information on the time zone in which the values were reported or by using the beginning instead of the end of the measurement period.

Furthermore, there has been a call for harmonized environmental data to make better interdisciplinary (environmental) policy. This led to Directive 2007/2/EC (INSPIRE) followed by Commission Regulation (EC) No 1205/2008, which stated that ISO standard 8601:2004(E) has to be used for time references of meta data (Annex, Part B paragraph 5). However, Commission Regulation 1205/2008 did not oblige MS to use the most extended format of the ISO standard.

To avoid any confusion or misinterpretation, additional criteria have been set in Decision 2011/850/EC. This is why the extended format, which includes the information on the difference with UTC, will be used as the default for any value originating from measurement or modelling results. For all measurement and modelling data types the timestamp of the start time and end time of the observation shall be given in the ISO extended time format.

NOTE: Samples with irregular time intervals should always be reported with the start and the end of the measurement period.

The extended format of time references according to ISO standard 8601:2004(E) and examples

The extended format of time references according to ISO standard 8601:2004(E) is defined as:

YYYY-MM-DDThh:mm:ss±hh:mm
where :

YYYY	represents the year
MM	represents the month
DD	represent the day

hh represents the hour
mm represents the minute
ss represents the second
±hh:mm represents the shift to UTC, so for CET it is +01:00

Note:
Summer time will not be used; i.e. MSs should report in local winter time with the corresponding time shift to UTC. Member States may also choose to report in another geographical time zone applicable to their territory. In all cases where time units are to be reported, the extended ISO 8601 format shall be used.

Hourly data in UTC => 2011-04-12T11:00:00Z
Hourly data in UTC+1 => 2011-04-12T11:00:00+01:00
Hourly data in UTC+2 => 2011-04-12T11:00:00+02:00

Midnight: The definition of "midnight" according to the same standard (ISO 8601:2004(E), paragraph 4.2.3) is as follows:

> "The complete representations in basic and extended format for midnight, in accordance with 4.2.2 (Local time), shall be expressed in either of the two following ways:
>
> | | Basic format | Extended format | |
> |---|---|---|---|
> | a) | 000000 | 00:00:00 | (the beginning of a calendar day) |
> | b) | 240000 | 24:00:00 | (the end of a calendar day) |
>
> The representations may have reduced accuracy in accordance with ISO 8601, paragraph 4.2.2.3 or may be designated as a time expression in accordance with 4.2.2.5 of the same ISO. To represent midnight the representations may be expanded with a decimal fraction containing only zeros in accordance with paragraph 4.2.2.4 of ISO 8601."

While in principle there are two possibilities within the extended format that can be used, **within the IPR Decision only the 24:00:00 format will be used to indicate the end of a measurement period**.

Table 1 Examples of time reference

Time reference	Time reference in IPR
12 April 1985 at 3 o'clock CET	1985-04-12T03:00:00+01:00
the midnight CET between 12 April 1985 and 13 April 1985	1985-04-12T24:00:00+01:00
the midnight CET between 30 April 1985 and 1 May 1985	1985-04-30T24:00:00+01:00
the midnight CET between 31 December 1985 and 1 January 1986	1985-12-31T24:00:00+01:00
21 June 2012 at 23 o'clock EET (Nicosia)	2012-06-21T23:00:00+02:00
27 November 2012 at 1 o'clock GMT (London)	2012-11-27T01:00:00Z

Other time references within 2011/850/EU

Decision 2011/850/EU requires more fields with a time reference. The list in Table 2 enumerates all time references within Decision 2011/850/EU other than the time references of dataset E.

Table 2 Other time references within Decision 2011/850/EU

Reference in Part II	**Description**	**ISO 8601 Format**
A.2.4.5	Reference year	YYYY
A.2.5.1 A.2.5.2	Start and end date of the period the exceedance situation applies	YYYY-MM-DD
B.6.2	Resident population reference year	YYYY
H.3	Date when dataset was made available	YYYY-MM-DD
H.4.5	Air Quality Plan: *Reference year of first exceedances*	YYYY
H.4.8	Air quality plan: date of official adoption	YYYY-MM-DD
I.2	Reference year	YYYY
J.1.5	Start year *(Reference year from which the projection starts)*	YYYY
J.1.6	Reference year from which the projections are started*(projection year)*	YYYY
K.2.8	Measure: time scale	see Code list *Time scale*
K.2.12.2 K.2.12.4	Implementation planned start and end date	YYYY-MM-DD
K.2.12.3 K.2.12.5	Implementation actual start and end date	YYYY-MM-DD
K.2.12.6	Date when the measure is planned to take full effect	YYYY-MM-DD
D.5.1.4.1 D.5.1.4.2	Start and end date of measurement configuration	YYYY-MM-DD
D.5.1.6.7.1.1	Sampling time	see Code list *Time unit*
D.5.1.6.7.2.1	Sampling interval	see Code list *Time unit*
D.6.3.7.1.1	Sampling time	see Code list *Time unit*
D.6.3.7.2.1	Sampling interval	see Code list *Time unit*
D.7.3.2.1 D.7.3.2.2	Time reference: Start and end of modelling period	YYYY-MM-DDThh:mm:ss±hh:mm
E.5.1 E.5.2 F.1.6.1 F.1.6.2	Time reference: start and end date of UTD data (i.e. discontinuous) Time reference: start and end date of aggregation period	*No fixed period of average:* YYYY-MM-DDThh:mm:ss±hh:mm *Highest 8th hour mean:* YYYY-MM-DDThh:mm:ss±hh:mm *Daily average:* YYYY-MM-DD *Annual average:* YYYY *Winter average:* $YYYY_0$-10-01T00:00:00±hh:mm and $YYYY_1$-03-31T24:00:00±hh:mm ($YYYY_1$=$YYYY_0$+1) *AEI:* $YYYY_0$-01-01T00:00:00±hh:mm and $YYYY_1$-12-31T24:00:00±hh:mm (for $YYYY_1$=$YYYY_0$+2) *AOT40:* $YYYY_0$-05-01T00:00:00±hh:mm and $YYYY_1$-07-31T24:00:00±hh:mm (for $YYYY_1$=$YYYY_0$+4)

(2) Number of significant digits and rounding

Legal reference:

Decision 2011/850/EC, Annex I part A(2)

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Data should be made available with the same number of digits as when obtained and processed in the monitoring network. Care has to be taken when rounding, since multiple numeric rounding can alter a numeric value in some cases. Therefore rounding shall be the very last step of any calculation, i.e. immediately before comparing the result with the environmental objective, and shall be done only once. By default the system will perform rounding of the data made available where appropriate and following the so-called commercial rounding rules.

Assessment data have to be compared to the environmental objectives (i.e. limit value, target value, etc) in the same numeric accuracy as is used for the specification of the environmental objective in the Directive. For the pollutants without an environmental objective, rounding should be done according to the rules described in *Table 3*.

Table 3 Rounding rules for pollutants without an environmental objective

Value x	**Number of decimals**	**Example : before rounding**	**Example: after rounding**
x ≥ 10	integer	17.83	18
1 ≤ x < 10	1 decimal	2.345	2.3
0.1 ≤ x < 1	2 decimals	0.865	0.87
0.01 ≤ x < 0.1	3 decimals	0.0419	0.042
Etc…			

Since negative assessment data have to be compared to the "negative detection limit" this table should apply to negative values as well.

Note:
AQUILA has recommended that in the case of polycyclic aromatic hydrocarbons the target value, lower and upper assessment thresholds should be quoted to the number of significant figures commensurate with the allowable uncertainty in their determination. In most cases this will mean two significant digits (e.g. target value of 1.0 ng/m^3 for benzo [a] pyrene). AQUILA's recommendation will be taken into account in any future revision of the relevant requirements.

Examples

1) A PM_{10} daily value of 50.486 µg/m³ is rounded to 50 µg/m³ applying commercial rounding rules.

[Note: if commercial rules are not applied then many possibilities of rounding could be founded (see also ISO 31-0:1992 (E), Annex B (4)): e.g. rounding this value in a first step to one digit gives 50.5 µg/m³ and rounding in a second step 51 µg/m³. When comparing this value to the daily limit value of 50 µg/m3 the result would be an exceedance. Thus it is important to follow the commercial convention.]

2) An ozone (O_3) hourly value of 180.49 µg/m^3 is rounded to 180 µg/m$^{3.}$ .When comparing this value to the hourly information threshold of 180 µg/m^3 the result would be no exceedance.

3) An ozone (O_3) hourly value of 180.50 µg/m^3 would be rounded to 181 µg/m^3 . When comparing this value to the hourly information threshold of 180 µg/m^3 the result would be an exceedance of the information threshold.

4) A benzo (a) anthracene yearly value of 1.428 ng/m^3 would be rounded to 1.4 ng/m^3.
[Note: benzo (a) anthracene is a pollutant without an environmental objective therefore *Table 3* shall be used]

(3) Equivalence

Legal reference:

-Directive 2008/50/EC , Annex 6, B
-Decision 2011/850/EU, ANNEX I part (A)

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The status of the measurement configuration with regard to equivalence shall be declared with an appropriate demonstration of equivalence flag. For measurements for which reference methods are defined by Directive 2008/50/EC or 2004/107/EC, primary assessment data must be flagged accordingly within the measurement configuration metadata.

The possible flags are:
- equivalence demonstrated
- equivalence not demonstrated
- demonstration not necessary, reference method used
- demonstration not possible, no reference method defined by Directive
- equivalence testing in progress.

The code list can be found at: http://dd.eionet.europa.eu/vocabulary/aq/equivalencedemonstrated

When more than one assessment method is used in a specific location, all data collected may be reported. However, for the purpose of checking compliance with the environmental objectives, the IPR decision states that the data derived from the assessment method exhibiting the lowest uncertainty at that specific location shall be used taking into account data capture rates. Determining the appropriate trade-off between uncertainty and data capture will require expert judgement. The method must thus be declared by the data provider rather than determined on the basis of outputs from prescribed aggregation routines.

(4) Standardisation

Legal reference:

-Directive 2008/50/EC, Annex VI,
-Directive 2004/107/EC, Annex IV,
-Decision 2011/850/EC, Annex I.

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According to the requirements of the above legislation, the following rules must be followed:

- for gaseous pollutants the volume must be standardised at a temperature of 293 K and an atmospheric pressure of 101,3 kPa;

- for particulate matter and substances to be analysed in particulate matter the sampling volumes refer to ambient conditions in terms of temperature and atmospheric pressure at the date of measurement.

The same provisions are to be used for reporting and exchanging information on other pollutants. These temperature and pressure provisions are to be used for the calculation of the conversion factor between mass fraction and mass concentration.

When measurement results for gaseous pollutants are expressed in ppb, conversion between ppb and µg/m^3 should be performed by the Member State. The conversion is temperature-dependent and based on the ideal gas law. The mechanism is given below.

Use of ppb should be avoided because it is not a SI unit but a coefficient (10^{-9}). As an SI correlate, it is recommended to use nmol/mol, i.e. 10^{-9} elements of substance of interest per mole of gas mixture. The conversion to mass per unit volume of gas can then easily be performed as follows:

Mass of 1 nmol in µg : 1.10^{-9} x 10^6 Mx, where Mx is the molar mass in grams.

Volume of 1 mol, V_0 (molar volume) in m^3: 22.414 10^{-3} m^3 at normal conditions T_0 = 273 K and P_0 = 101,3 kPa.

The molar volume at other conditions, T_1 and P_1 , can be derived from the ideal gas law

$$\frac{p_0 \times V_0}{T_0} = \frac{p_1 \times V_1}{T_1}$$

$P_1 = P_0$ = 101.3 kPa
Thus the conversion can be derived with the following formula:

$$X[\mu g / m^3] = X[ppb] \times \frac{M_X}{V_0} \times \frac{T_0}{T_1} \times \frac{p_1}{p_0}$$

where : p_0 = 101.3 kPa
T_0 = 273 K
V_0 = 22.414 l/mol.

The conversion factors as described in the EN standards for various pollutants (T_1=293 K) are presented in Table 4. Conversion factors presented at least to this level of accuracy should be used in monitoring networks.

Table 4 Conversion factors

Pollutant	$M_{Pollutant}$ [g/mol]	Factor
NO_2	46,00449	1,912
NO	30,00546	1,247
O_3	47,99709	2,00
SO_2	64,05706	2,66
CO	28,00863	1,16
C_6H_6	78,10464	3,25

NOx is given as the sum of nitric oxide and nitrogen dioxide added as parts per billion and expressed as nitrogen dioxide in µg/m^3 as follows:

NO [ppb] + NO_2 [ppb] $\rightarrow$ NO_x (as NO_2) [ppb] $\rightarrow$ NOx (as NO_2) [µg/m³]

that is:

NO_x (as NO_2) [µg/m³]=NO_2[µg/m^3]+NO[µg/m^3]*1.912/1.247

The first step is the simple addition of NO and NO_2 in ppb. If the data is stored in µg/m³ the conversion to ppb has to be done beforehand.

(5) Provisions for $PM_{2.5}$

(i) Calculation of the Average Exposure Indicator (AEI)

Legal reference:

- Directive 2008/50/EC, Annex XIV (A),
- Decision 2011/850/EU, Annex I, (5).

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Part A of Annex XIV of Directive 2008/50/EC defines that the AEI shall be assessed as a three-calendar year running annual mean concentration averaged over all sampling points established pursuant to Section B of Annex V of the Directive.

So the AEI for the reference year 2010 shall be the mean concentration of the years 2008, 2009 and 2010. However, where data are not available for 2008, Member States may use the mean concentration of the year 2009 or 2010 or the mean concentration of the years 2009, 2010 and 2011. Member States were obliged to inform the Commission of the chosen option.

To ensure transparent and unambiguous calculation of the reported AEI, the following procedure shall be observed:

- calculate the annual average $PM_{2.5}$ concentration at each AEI monitoring station, applying the criteria laid down in Annex XI.A of Dir. 2008/50/EC for each year;
- calculate the average of all AEI monitoring stations within the MS for each year;
- calculate the average over three years (the actual reporting year, and the two years before or, where less than 3 consecutive years is available for the periods 2009-2010 or 2009 – 2011, as set above).

These aggregation steps must be applied to data with numeric accuracy available in the monitoring network. Rounding must be done at the end of the aggregation procedure.

Any modification of the set of AEI monitoring stations and measurement configuration is strongly discouraged. The selection of the sampling points must be documented in dataset D.

The AEI shall be reported annually as a three year running mean.

Note:
The National Exposure Reduction Target (NERT) according to the Directive 2008/50/EC, Annex I, B will be established based on the first reporting of AEI. According to the Member States, difficulties

were encountered in calculating the first AEI mainly because it was not possible to attain 90% data capture for all sites for various reasons (e.g. insufficient time to choose the monitoring sites and to install the equipment). Due to the importance of having a basis for establishing the NERT, AQUILA has produced guidance recommending how to deal with the AEI when data capture of 90% is not fulfilled for some stations. Therefore, if data capture of ≥ 90% was not achieved in practice, it is recommended to follow the procedure recommended by AQUILA. [*see AQUILA, 2012*]. Other procedures/methods may be used provided that they are well documented [e.g. Spanish Royal Decret 102/2011].

(ii) Exposure concentration obligation

Legal reference: Directive 2008/50/EC, Annex XIV, C

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The AEI for the year 2015 shall be the three-year running mean concentration averaged over all sampling points for the years 2013, 2014 and 2015. The AEI is used for establishing whether the exposure concentration obligation is met. The Average Exposure Indicator shall therefore be used for the reporting of exposure concentration obligation.

(iii) National Exposure Reduction Target (NERT)

Legal reference: Directive 2008/50/EC, Annex XIV, B

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The NERT is relative to the first reporting of AEI and the Directive provisions entail that different reduction targets will apply depending on the first value of AEI.

Note:

AQUILA has recommended that the initial AEI concentration thresholds should be presented with one decimal i.e. 8.5, 13.0, 18.0 and 22.0 µg/m^3, and that in order to be consistent, also the numerical accuracy of the AEI obtained in practice in a MS should be rounded to 1 decimal. The legal position is that the level of accuracy specified in the legislation is the relevant basis for comparison (see section (2) Number of significant digits and rounding). The Directive presents the last three thresholds rounder to integer accuracy, and so at present, also the numerical accuracy of the AEI obtained in the MS should be rounded to the nearest integer for comparison with these thresholds. However, AQUILA's recommendation will be taken into account in any future revision of the relevant requirements.

(B) Environmental objectives and reporting metrics

Legal reference:

Decision 2011/850/EC, Article 2:
'environmental objective' means an ambient air quality objective to be attained within a given period, or where possible over a given period respectively or in the long term as laid down in Directives 2004/107/EC and 2008/50/EC.

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A complete list of environmental objectives and reporting metrics compared with the Airbase list is published by the EEA at:

http://dd.eionet.europa.eu/vocabulary/aq/objectivetype/view

and

http://dd.eionet.europa.eu/vocabulary/aq/reportingmetric/view

Table 5 Environmental objective and reporting metrics as described in 2011/850/EU

Formula	**Protection target**	**Environmental Objective (Code[1])**	**Averaging period of assessments**	**Reporting Metric of environmental objective**	**Numerical values of the environmental objective (or allowed no. of exceedances)**
Pollutants for which up-to-date and validated data have to be reported					
NO_2	Health	LV	One hour	Hours in exceedance in a calendar year	200 µg/m³ (18)
		LVMT			
		LV	One Calendar year	Annual average	40 µg/m³
		LVMT			
		ALT	One hour	Three consecutive hours in exceedance (at locations representative of air quality over at least 100km^2 or an entire zone or agglomeration, whichever is smaller)	400 µg/m³
NO_x	Vegetation	CL	One Calendar year	Annual average	30 µg/m³
PM_{10}	Health	LV	One day	Days in exceedance in a calendar year	50 µg/m³ (35) 90.4 percentile
		LV	One Calendar year	Annual average	40 µg/m³
		WSS[2]	One day	Deducted days in exceedance in a calendar year	n.a.
			One Calendar year	Deduction of annual average	n.a.
		NAT[2]	One day	Deducted days in exceedance in a calendar year	n.a.
			One Calendar year	Deduction of the annual average	n.a.
$PM_{2.5}$	Health	ECO	Three subsequent calendar years	Average Exposure Indicator: (calculation see Directive 2008/50/EC)	20 µg/m³
		ERT			in accordance with Annex XIV, Part B to Directive 2008/50/EC
		TV	One Calendar year	Annual average	25 µg/m³ (2010)
		LV			25 µg/m³ (2015)
		NAT		Deduction of the annual average	n.a.
SO_2	Health	LV	One hour	Hours in exceedance in a calendar year	350 µg/m³ (24)
			One day	Days in exceedance in a calendar year	125 µg/m³ (3)

Formula	Protection target	Environmental Objective (Code[1])	Averaging period of assessments	Reporting Metric of environmental objective	Numerical values of the environmental objective (or allowed no. of exceedances)
		ALT	One hour	Three consecutive hours in exceedance (at locations representative of air quality over at least 100km^2 or an entire zone or agglomeration, whichever is smaller)	500 µg/m³
		NAT[2]	One hour	Deducted hours in exceedance in a calendar year	n.a.
			One day	Deducted days in exceedance in a calendar year	n.a.
	Vegetation	CL	One Calendar year	Annual average	20 µg/m³
			Winter	Average value over the winter months, i.e. 1 October year x-1 to 31March year x	20 µg/m³
O_3	Health	TV	Maximum daily 8-hour mean	Days when maximum daily 8-hour mean exceeded the target value averaged over three years	120 µg/m³ (25)
		LTO	Maximum daily 8-hour mean	Days when maximum daily 8-hour mean exceeded the long term objective in one calendar year	120 µg/m³
		INT	One hour	Hours in exceedance in a calendar year	180 µg/m³
		ALT	One hour	Hours in exceedance in a calendar year	240 µg/m³
	Vegetation	TV	1 May to 31 July	AOT40 averaged over 5 years	18000 µg/m³·h
		LTO	1 May to 31 July	AOT40 averaged over 1 year	6000 µg/m³ ·h
CO	Health	LV	Maximum daily 8-hour mean	Days when maximum daily 8-hour mean exceeded the limit value	10 mg/m³
Pollutants for which only validated data have to be reported					
Benzene	Health	LV	One Calendar year	Annual average	5 µg/m³
Pb	Health	LV	One Calendar year	Annual average	0.5 µg/m³
Cd	Health	TV	One calendar year	Annual average	5 ng/m³
As	Health	TV	One calendar year	Annual average	6 ng/m³
Ni	Health	TV	One calendar year	Annual average	20 ng/m³
B(a)P	Health	TV	One calendar year	Annual average	1 ng/m³

[1] LV: limit value, LVMT: Limit value plus margin of tolerance, TV: target value, LTO: long-term objective, INT: Information threshold, ALT: Alert threshold, CL: Critical level, NAT: Assessment of

natural contribution, WSS: Assessment of winter sanding and salting, ERT: Exposure reduction target, ECO: Exposure concentration obligation;
[2] No up-to-date data is to be made available for NAT and WSS which are not environmental objective as such.

(C) Pollutants with monitoring requirements

Legal references:

Directive 2008/50/EC, Article 2:
'pollutant' shall mean any substance present in ambient air and likely to have harmful effects on human health and/or the environment as a whole;

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(i) Pollutants with monitoring requirements referred to in Directive 2004/107/EC and 2008/50/EC

A complete list of pollutants compared with Airbase list is published by EEA at URL:

http://dd.eionet.europa.eu/vocabulary/aq/pollutant/view

while in Table 6 the list of pollutants as described in 2008/50/EC is presented.

Table 6 Pollutants with monitoring requirements as described in 2011/850/EU

Airbase code	Pollutant formula	Pollutant name	Measurement unit
Gaseous inorganic pollutants			
1	SO_2	Sulphur dioxide	µg/m³
8	NO_2	Nitrogen dioxide	µg/m³
9	NOx[1]	Nitrogen oxides	µg/m³
7	O_3	Ozone	µg/m³
10	CO	Carbon monoxide	mg/m³
Particulate Matter (PM)			
5	PM_{10}	PM_{10}	µg/m³
6001	$PM_{2.5}$	$PM_{2.5}$	µg/m³
$PM_{2.5}$ Speciation			
1047	SO_4^{2-} in $PM_{2.5}$	Sulphate in $PM_{2.5}$	µg/m³
1046	NO_3^- in $PM_{2.5}$	Nitrate in $PM_{2.5}$	µg/m³
1045	NH_4^+ in$PM_{2.5}$	Ammonium in $PM_{2.5}$	µg/m³
1771	elem. C in $PM_{2.5}$	Elemental Carbon in $PM_{2.5}$	µg/m³
1772	org. C in $PM_{2.5}$	Organic Carbon in $PM_{2.5}$	µg/m³
1629	Ca^{2+} in $PM_{2.5}$	Calcium in $PM_{2.5}$	µg/m³
1659	Mg^{2+} in $PM_{2.5}$	Magnesium in $PM_{2.5}$	µg/m³
1657	K^+ in $PM_{2.5}$	Potassium in $PM_{2.5}$	µg/m³
1668	Na^+ in $PM_{2.5}$	Sodium in $PM_{2.5}$	µg/m³
1631	Cl^-in $PM_{2.5}$	Chloride in $PM_{2.5}$	µg/m³
Heavy Metals			
5012	Pb	Lead in PM_{10}	µg/m³
5014	Cd	Cadmium in PM_{10}	ng/m³
5018	As	Arsenic in PM_{10}	ng/m³

Airbase code	Pollutant formula	Pollutant name	Measurement unit
5015	Ni	Nickel in PM_{10}	ng/m³
Heavy Metals Deposition			
7012	Pb deposition	wet/total Pb deposition	µg /(m².day)
7014	Cd deposition	wet/total Cd deposition	µg /m².day)
7018	As deposition	wet/total As deposition	µg /(m².day)
7015	Ni deposition	wet/total Ni deposition	µg /(m².day)
7013	Hg deposition	wet/total Hg deposition	µg /(m².day)
Mercury			
4013	Metallic gaseous Hg	elemental gaseous Mercury	ng/m³
4813	Total gaseous Hg	Total gaseous Hg	ng/m³
653	Reactive gaseous Hg	reactive gaseous Mercury	ng/m³
5013	Particulate Hg	particulate Mercury	ng/m³
Polycyclic Aromatic Hydrocarbons			
5029	B(a)P	Benzo(a)pyrene in PM_{10}	ng/m³
5610	Benzo(a)anthracene	Benzo(a)anthracene in PM_{10}	ng/m³
5617	Benzo(b)fluoranthene	Benzo(b)fluoranthene in PM_{10}	ng/m³
5759	Benzo(j)fluoranthene	Benzo(j)fluoranthene in PM_{10}	ng/m³
5626	Benzo(k)fluoranthene	Benzo(k)fluoranthene in PM_{10}	ng/m³
5655	Indeno(1,2,3,-cd)pyrene	Indeno(1,2,3,-cd)pyrene in PM_{10}	ng/m³
5419	Dibenzo(a,h)anthracene	Dibenzo(a,h)anthracene in PM_{10}	ng/m³
Polycyclic Aromatic Hydrocarbons Deposition			
7029	B(a)P	Benzo(a)pyrene deposition	µg /(m².day)
611	Benzo(a)anthracene	Benzo(a)anthracene deposition	µg /(m².day)
618	Benzo(b)fluoranthene	Benzo(b)fluoranthene deposition	µg /(m².day)
760	Benzo(j)fluoranthene	Benzo(j)fluoranthene deposition	µg /(m².day)
627	Benzo(k)fluoranthene	Benzo(k)fluoranthene deposition	µg /(m².day)
656	Indeno(1,2,3,-cd)pyrene	Indeno(1,2,3,-cd)pyrene deposition	µg /(m².day)
7419	Dibenzo(a,h)anthracene	Dibenzo(a,h)anthracene deposition	µg /(m².day)
Volatile Organic Components			
20	C_6H_6	Benzene	µg/m³
428	C_2H_6	Ethane	µg/m³
430	C_2H_4	Ethene (ethylene)	µg/m³
432	$HC{\equiv}CH$	Ethyne (acetylene)	µg/m³
503	$H_3C\text{-}CH_2\text{-}CH_3$	Propane	µg/m³
505	$CH_2{=}CH\text{-}CH_3$	Propene	µg/m³
394	$H_3C\text{-}CH_2\text{-}CH_2\text{-}CH_3$	n-butane	µg/m³
447	$H_3C\text{-}CH(CH_3)_2$	2-methylproprane (i-butane)	µg/m³
6005	$H_2C{=}CH\text{-}CH_2\text{-}CH_3$	1-butene	µg/m³
6006	$H_3C\text{-}CH{=}CH\text{-}CH_3$	trans-2-butene	µg/m³
6007	$H_3C\text{-}CH{=}CH\text{-}CH_3$	cis-2-butene	µg/m³
24	$CH_2{=}CH\text{-}CH{=}CH_2$	1,3-butadiene	µg/m³
486	$H_3C\text{-}(CH_2)_3\text{-}CH_3$	n-pentane	µg/m³
450	$H_3C\text{-}CH_2\text{-}CH(CH_3)_2$	2-methylbutane (i-pentane)	µg/m³
6008	$H_2C{=}CH\text{-}CH_2\text{-}CH_2\text{-}CH_3$	1-pentene	µg/m³
6009	$H_3C\text{-}HC{=}CH\text{-}CH_2\text{-}CH_3$	2-pentenes	µg/m³
451	$CH_2{=}CH\text{-}C(CH_3){=}CH_2$	2-methyl-1,3-butadiene (isoprene)	µg/m³
443	C_6H_{14}	n-hexane	µg/m³
316	$(CH_3)_2\text{-}CH\text{-}CH_2\text{-}CH_2\text{-}CH_3$	2-methylpentane (i-hexane)	µg/m³
441	C_7H_{16}	n-heptane	µg/m³
475	C_8H_{18}	n-octane	µg/m³

Airbase code	Pollutant formula	Pollutant name	Measurement unit
449	$(CH_3)_3$-C-CH_2-CH-$(CH_3)_2$	2,2,4-trimethylpentane (i-octane)	µg/m³
21	C_6H_5-CH_3	Toluene	µg/m³
431	C_6H_5-C_2H_5	Ethyl benzene	µg/m³
464	m,p-$C_6H_4(CH_3)_2$	m,p-xylene	µg/m³
482	o-C_6H_4-$(CH_3)_2$	o-xylene	µg/m³
6011	$C_6H_3(CH_3)_3$	1,2,4-trimethylbenzene	µg/m³
6012	$C_6H_3(CH_3)_3$	1,2,3-trimethylbenzene	µg/m³
6013	$C_6H_3(CH_3)_3$	1,3,5-trimethylbenzene	µg/m³
32	THC(NM)	total non-methane hydrocarbons	µg/m³
25	HCHO	Methanal (formaldehyde)	µg/m³

[1] NO_x or the sum of NO and NO_2 measured at the same monitoring site can be reported. To be reported as µg NO_2 /m³.

(ii) Pollutants not listed in Directive 2004/107/EC and 2008/50/EC

Legal reference:

Decision 2011/850/EU - ANNEX I (C) provides:
a list including further pollutants on which Member States shall have reciprocal data exchange, as available, which is kept by the European Environment Agency and is made available at the portal mentioned in the summary.

***

The complete up-to-date list of pollutants (RDF data model) is published by the EEA at:

http://dd.eionet.europa.eu/vocabulary/aq/pollutant/view

(iii) Units of Measurement

Legal reference: Decision 2011/850/EU - ANNEX I , (B) and (C). The measurement units are presented in table (B) "Environmental objectives and reporting metrics" and Table (C) "Pollutants with monitoring requirements" of Annex I of Decision 2011/850/EU.

***

Table 6 above, and the complete list of pollutants compared with the Airbase list published by the EEA (below), contain also the units of measurement to be used:

http://dd.eionet.europa.eu/vocabulary/aq/observationunit/view

ANNEX II OF DECISION 2011/850/EU

(A) Common Data types

The description of the different fields for the common data types are given in the second part of this guidance "schemata".

(B) Information on zones and agglomerations (Article 6)

Legal references:

-Article 4 of Directive 2008/50/EC
-Article 6 of Decision 2011/850/EU

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Information on the zones and agglomerations applicable for a specific calendar year must be made available on a preliminary basis before the end (i.e. 31st December) of the previous year (Art. 6.2). Descriptions of the different elements to be reported are provided in the second part of this guidance. Where changes are made to the zones and agglomerations that were preliminarily reported, an updated dataset shall be made available – together with datasets D to G – by 30th September of the following year (Art. 6.3). **In case of a change of boundary for a zone, a new identifier for that zone has to be provided.**

Air quality zones have to be delineated as a GIS (Geographic Information System) representing the spatial extent encoded in GML. This can be a single polygon or - in case of discontinuous representativeness area - aggregated polygons or exclusions. The individual polygons are each defined as a list of coordinates; this type includes geometry specification (geodetic coordinate reference system). The latter should be used only in case of discontinuous air quality zones. On a voluntary basis, the relevant Local Administrative Unit codes should be provided. Where the area of the zone is large and is consistent with administrative boundaries at a higher level (NUTS codes etc) these may be used for efficient declaration of the boundary of a zone.

The complete code lists are published on the portal at:

http://dd.eionet.europa.eu/vocabulary/aq/zonetype/view
http://dd.eionet.europa.eu/vocabulary/common/nuts/
http://dd.eionet.europa.eu/vocabulary/common/lau/

Note:
Member States shall not change the delimitation of the air quality zones subject to time extension without prior approval from the Commission as mentioned in the respective Decisions.

Code of zone

Legal references:

Article 6 of Decision 2011/850/EC

***

A unique unambiguous code of the zone has to be generated by the Member State and used for the reporting.

The zone code consists of the ISO 3166-1 country code followed by any unique combination of numbers or letters selected by the Member State

The ISO 3166-1 country code is available at:
http://www.iso.org/iso/country_names_and_code_elements

As mentioned before, when there is a change of boundary for a zone, a new identifier (i.e. new code) for that zone has to be provided.

(C) Information on the assessment regime (Article 7)

Legal references:

-Article 4 of Directive 2004/107/EC
-Article 5 of Directive 2008/50/EC
-Article 7 of Decision 2011/850/EU
all define the "assessment regime".

***

Guidance on assessment can be found at
http://ec.europa.eu/environment/air/pdf/guidanceunderairquality.pdf

The complete code lists are published on the portal at:

http://dd.eionet.europa.eu/vocabulary/aq/assessmentthresholdexceedance

and

http://dd.eionet.europa.eu/vocabulary/aq/assessmenttype/

(i) Classification of zones in relation to assessment thresholds

Legal references:

-Article 5 of 2008/50/EC and Article 4 of 2004/107/EC specify that Air Quality (AQ) zones shall be classified in relation to assessment thresholds on, at a minimum, a 5-year cycle, and more frequently in the event of significant changes in activities relevant to the ambient concentrations.
-Article 7 of Decision 2011/850/EU states that MS shall make available the information on the assessment regime to be applied for each zone and pollutant in the following calendar year.

***

The objective of an assessment regime is to benchmark the levels of pollutants with environmental objectives and based on these levels establish a proportionate regime or system for the assessment and management of air quality going forward. An assessment regime may include a variety of assessment types:

- Fixed measurement
- Indicative measurement
- Modelling
- Objective Estimation

or a combination of these.

The selection of the assessment type will depend upon the observed pollution levels in relation to the Assessment Thresholds specified in Annex II of 2008/50/EC and Annex I 2004/107/EC.

Where for a given pollutant a certain LV metric is clearly more stringent than the others (e.g. the annual mean NO2 metric vs the 1-hour NO2 metric) the Lower Assessment Threshold /Upper Assessment Thresholds should be applied based on the stricter metric (i.e. in this case the annual mean) as a conservative indicator of levels and scope of public health exposure assessment required.

Where the stringency of LV metrics is not easy to differentiate e.g. PM10, the assessment should be performed for both metrics and the worst exceedance status chosen from each assessment on a zone by zone basis.

Table 7 Assessment regime options allowed based on preliminary assessment of pollutant levels

Pollutants	**Pollution level**[1]	**Considered period**[2,3]	**Assessment regime**
SO_2, NO_2, NO_x, PM_{10}, $PM_{2.5}$, Pb, C_6H_6, CO As, Cd, Ni, BaP	Pollution level > UAT	At least three of the previous five years	Fixed measurements shall be used, possibly supplemented by modelling techniques and/or indicative measurements.
SO_2, NO_2, NO_x, PM_{10}, $PM_{2.5}$, Pb, C_6H_6, CO As, Cd, Ni, BaP	Pollution level ≤ UAT and > LAT	At least three of the previous five years	Fixed measurements may be combined with modelling techniques and/or indicative measurements.
SO_2, NO_2, NO_x, PM_{10}, $PM_{2.5}$, Pb, C_6H_6, CO As, Cd, Ni, BaP	Pollution level ≤ LAT	At least three of the previous five years	Modelling techniques or objective estimation techniques are sufficient.
O_3	Pollution level > LTO	Any of the previous five years of measurement	Fixed measurements shall be used, possibly supplemented by modelling techniques and/or indicative measurements.

[1] UAT: upper assessment threshold; LAT: lower assessment threshold; LTO: long term objective

[2] When insufficient data are available for the previous three or five years, Member States may combine measurements campaigns of shorter duration during the period of the year and at locations likely to be typical of the highest pollution level with results obtained from information from emission inventories and modelling to determine exceedances of the upper and lower assessment threshold (see also Article 9 and Annex II, B of 2008/50/EC)

[3] Independent of the sampling point in the zone, i.e. the location of the maximum observed annual concentration does not need to be the same over the considered period.

Assessment must be carried out in accordance with the Guidance on Assessment under the EU Air Quality Directives that can be found at:
http://ec.europa.eu/environment/air/pdf/guidanceunderairquality.pdf

***

The Assessment Regime data set (Dataset C) is applicable for a specific calendar year and in accordance with Article 7.2 of Decision 2011/850/EU, must be reported before the end of the previous year (i.e. a forward looking submission made by 31 December for the forthcoming year). A change notification of a pre-existing submission is acceptable in the event of minor change. This change notification is acceptable to report changes to the assessment methods applied i.e. where stations or sampling points or their configurations are closed and replaced, the change notification delivery only needs to contain information relating to the stations closing or opening. Reclassification/review of zones status based on a new 5-year period or in the event of significant changes in activities will require a full resubmission of the Assessment Regimes data set.

All information about the assessment shall be provided for each zone and for each pollutant using the list of information set out in Part C of Annex II of the Decision 2011/850/EU. The information to be provided shall be the result of an assessment done by the MS and will not be automatically generated by the routines of the EEA Portal. However, the Portal will host routines that will support MS when a 5 year time series of data is available.

Documentation of the classification of zones in relation to the assessment thresholds should be made available to the Commission and public through a link; that is, the procedure for determining whether a zone is below the lower assessment threshold, between the lower and upper thresholds, or above the upper threshold, shall be documented and made available through a link.

(D) Information on the assessment methods (Articles 8 and 9)

Sub-section (i), (ii), (iii) and (iv) of this section provide guidance on fixed measurement, indicative measurement, modelling and objective estimation respectively. Sub-section (v) covers guidance on Data Quality Objectives common to each of the above.

(i) Fixed measurement and measurement techniques

Fixed measurement information (Annex II D(ii))

Legal reference:

Decision 2011/850/EU - ANNEX II - (D) Information on the assessment methods , (ii) "Fixed measurement Information" describes the information to be made available by the Member States (mandatory or voluntary).
Decision 2011/850/EU, Article 2:
(1) 'Station' means a location where measurements and/or samples are taken at one or more sampling points at the same site within an area of some 100 m².
(2) 'Network' means an organisational structure performing assessment of ambient air quality by measuring at one or more stations.

***

The information on monitoring stations (under D.5.2) has to be provided for each monitoring station. Each monitoring station may have several different measurement configurations (sampling points), which are pollutant specific. The information on measurement configurations (dataset D.5.1) shall therefore be provided for each measurement configuration that is being operated at a station.

The competent bodies e.g. monitoring networks, which are responsible for station maintenance and Quality Assurance /Quality Control (QA/QC) procedures are nominated by the Member States.

More detailed guidance is provided on specific points of Annex II D (ii) below; the numbering reflects the numbering of points in the IPR Annex itself.

Code of the station (4)

Legal reference:

Decision 2011/850/EU, ANNEX II - (D) Information on the assessment methods; point (4) mentions 'station code' as one of the pieces of information that MS should report.

***

A unique unambiguous code of the Station has to be generated by the Member State and used for the reporting. The previous rules used for AIRBASE shall be used for the generation of this code.

The IPR station code has the format structure CCXXXXX, where
<CC> : the ISO 3166-1 country code;
<XXXXX> : any unique combination of numbers or letters selected by the Member State

The ISO 3166-1 country code is available at:
http://www.iso.org/iso/country_names_and_code_elements

Note:
At present, two types of station codes exist which are identical in format but have different characters as a suffix. The two types are those for reporting to Airbase, and those for reporting to EMEP and the EBASE database. The format is a 2 character ISO country code, 4 digit sequence number per country and "A" (indicating AIRBASE) or R for EBASE.

Airbase codes will be generated by Member States in future rather than by the Data Exchange Module. Member States should be aware that where a station is also to be used for reporting to EMEP, the station code will need to be generated by EMEP instead so that it ends in an R.

Name of the monitoring station (5)

Legal reference:

Decision 2011/850/EU, ANNEX II - (D) Information on the assessment methods, point (5) mentions 'Name of the monitoring station' as one of the pieces of information that MS should report.

***

The name of the station should be the same as used for national reporting and for providing information to the public.

In Table 8 some examples for station names are given. It is recommended that the station names should be unambiguous and remain unchanged over time.

Table 8 Recommendation for station names

Type of location	Recommended name	Examples
urban areas	name of the town or municipality + name of street, place or significant location nearby	Berlin Frankfurter Allee Wien Stephansplatz Bristol St. Pauls Datteln Bahnhof
suburban areas	name of the town or municipality + name of district, suburb, street, place or significant location nearby	Innsbruck Sadrach Duisburg-Bruckhausen Modena - Castelfranco
small settlements (with only one monitoring site)	name of municipality	Mistelbach Fulda
rural stations	either name of nearby village name of mountain, landscape area	Illmitz Westerland Jungfraujoch

Not recommended station names (examples from AirBase):

- Vague information about the location within a town (e.g. “Centre”, “North”).
- Inappropriate station code in the station name, which can cause confusion (e.g. DENW132: Siegen Haardter Berg)
- Abbreviations of locations (e.g. “Reading HC")
- -Landscape and street names referring to large areas, which give no detailed information about the location (e.g. “Spessart”, “Dunkelsteinerwald”)
- Name of town missing in case of urban stations: (e.g. “University”, “Rautatienkatu”, “Giulio Cesare”)
- An abbreviation of the town name giving insufficient information (e.g. “Pha10-Pocernicka” for a station in Prague, “HH Billstedt” for a station in Hamburg)
- Only a town name in case of agglomerations or large towns (e.g. “Glasgow”)
- No information about the location (e.g. “Exeter traffic”, “Glasgow kerbside”)
- Number instead of location (e.g. “Castrop-Rauxel 6”, “Copenhagen/1257”, “London 1”)
- Station code instead of station name (e.g. RO21101)
- Meaningless abbreviations (e.g. “R.D.S.”)

Such names should be avoided.

Equivalence (13)

Legal reference:

-Directive 2008/50/EC , Annex 6, B
-Decision 2011/850/EU, ANNEX I part (A)

***

Non-reference measurement methods can also be used provided they respect provisions for equivalence set out in the Directives (see for example 2008/50/EC, Annex VI). A Commission Working Group on Equivalence prepared a document describing principles and methodologies to be used for the demonstration of the equivalence of alternative (non-reference) measurement methods to the reference methods described by the EN Standard methods. The Ambient Air Quality Committee established under Directive 2008/50/EC has endorsed an updated version of the guidance for the implementation of the Directive 2008/50/EC. The guidance and the corresponding tool are available:

http://ec.europa.eu/environment/air/quality/legislation/assessment.htm

Note:
In exceptional cases, when PM_{10} concentrations are measured with two different instruments at one site i.e. tapered element oscillating microbalance with filter dynamic measurement system (TEOM – FDMS) and TEOM + correction, if the data from TEOM-FDMS are missing then in order to increase the data capture it should be possible to replace those data by corrected TEOM data provided that both methods have been demonstrated to be equivalent to the reference method. Note that the responsibility to do this lies with the Member States.

Evaluation of representativeness (17)

Legal reference:

-Decision 2011/850/EU, ANNEX II - (D) Information on the assessment methods lists the "Evaluation of representativeness " as information that MS should report, if available.

***

There is as yet no definition of the spatial representativeness of monitoring stations in the AQ legislation and there is a need to develop tools for its quantitative assessment.

In 2007, a study was conducted for the Commission by the UBA Austria to investigate ways of facilitating a more harmonized approach to the classification of monitoring stations. The report can be found at:
http://ec.europa.eu/environment/air/quality/legislation/pdf/report_uba.pdf.

A recent paper of Joly and Peuch (2011) described another method based only on the past time series of the measured pollutant.

The evaluation of representativeness will be further evaluated in the framework of the collaboration between AQUILA/FAIRMODE. Once this analysis is concluded, a final recommendation will be included in this guidance.

Local and regional dispersion situation (D.5.2.11 of Part II)

Local Dispersion Situation describes the location of the station in relation to nearby buildings. The description of local dispersion situations refers to ground level. The height of the air inlet above ground level is described elsewhere in dataset (D).

A complete code list is published by EEA at:

http://dd.eionet.europa.eu/vocabulary/aq/dispersionlocal

Table 9 Recommendations for assessing the local dispersion situation

Street canyon	Continuous/compact buildings along both sides of the street over more than 100 m. Average ratio of height of buildings to width of street > 0,5. (for this purpose "street" means the distance between the two facades of the buildings opposing each other, so including any pavements, gardens, etc.)
Detached buildings or one-sided compact buildings	Detached buildings on both sides of the street. Compact buildings on one side of the street, few buildings on the other side. Forest or groups or large trees in a surrounding of some 10 m
Open terrain	Flat area without large buildings or large trees in a surrounding of several 10 m
Elevated terrain	Summit, slope or saddle. Relative altitude of the station at least some 10 m related to surroundings of some 100 m. Monitoring stations located on towers or high buildings are not considered as “elevated”.

Regional dispersion situation describes the topographic situation on a scale of several kilometres. A complete code list is to be found at:

http://dd.eionet.europa.eu/vocabulary/aq/dispersionregional/view

Table 10 Recommendation for assessing the regional dispersion situation

Plane terrain	Flat area on a scale of several 10 km with relative altitudes less than 100 m
Hilly terrain	Area with relative altitudes between 100 and 300 m on a scale of several 10 km
Mountainous terrain – slope	Area with relative altitudes between 300 and 1000 m on a scale of some 10 km. Slope characterizes locations neither on valley bottom not on ridge, summit or pass
Mountainous terrain – ridge, pass or summit	Area with relative altitudes between 300 and 1000 m on a scale of some 10 km.
High alpine terrain	Area with relative altitudes above 1000 m on a scale of some 10 km, not located at the bottom of a valley or basin
Valley in hilly terrain	Bottom of a valley (relative altitude less than 100 m) in hilly terrain
Valley in mountainous terrain	Bottom of a valley (relative altitude less than 100 m) in mountainous or alpine terrain
Basin in hilly terrain	Bottom of a basin (relative altitude less than 100 m) in hilly terrain. A basin is characterized as flat or hilly terrain on a scale of 5 to some 10 km surrounded by hilly or mountainous terrain.
Basin in mountainous terrain	Bottom of a basin (relative altitude less than 100 m) in mountainous terrain.
Basin partly surrounded by mountains	Bottom of a basin (relative altitude less than 100 m) located at the border of mountains, surrounded by alpine or mountainous terrain on one side and flat or hilly terrain on the other side.
Coast with plane terrain in interior	Marine coast with plane or hilly terrain (see above) in its interior
Coast with mountainous terrain in interior	Marine coast with mountainous or alpine terrain (see above) in its interior

Type of network (D.5.3.3 of Part II)

Description of the spatial scale the network covers, to be selected from the Code list Network Type. The complete Code list is published on the portal at:

http://dd.eionet.europa.eu/vocabulary/aq/networktype/view

Table 11 Type of networks

Local	designed for the observation of single emission sources
Urban	designed at the spatial level of an agglomeration or conurbation
Regional	designed at the spatial level of an administrative unit of some 1000s to some 10.000s km²
National (Entire country)	designed at national level
Other	e.g. networks comprising monitoring sites in more than one country; networks targeted at special ecosystem monitoring.

Station classification in relation to prominent emission sources (22)

Legal reference:

Decision 2011/850/EU, in ANNEX II - (D) Information on the assessment methods lists the "Classification of station in relation to predominant emission sources relevant for the measurement configuration for each pollutant" as one of the pieces of information that MS should report.

***

Table 12 includes recommendations as regards the classification of station in relation to dominant emission sources as defined in the Exchange of Information (97/101/EC). The complete code list is published on the portal at:

http://dd.eionet.europa.eu/vocabulary/aq/stationclassification

Table 12 Station classification in relation to predominant emission sources in accordance with the macro scale siting criteria

Traffic	Located in close proximity to a single major road.
Industrial	Located in close proximity to a single industrial source or industrial area. A wide range of industrial sources can be considered here, including ➢ thermal power generation ➢ district heating plants ➢ refineries ➢ waste incineration/treatment plants, dump sites ➢ mining, including gravel, oil, natural gas ➢ airports ➢ ports
Background	Any location with is neither to be classified as “traffic” or “industrial”. Located such that its pollution levels are representative of the average exposure of the general population (or vegetation and natural ecosystems) within the type of area under assessment. The

	pollution level should not be dominated by a single source type (e.g. traffic), unless that source type is typical within the area under assessment. The station should usually be representative of a wider area of at least several square kilometres

* this table is recommended by the SCREAM document - Assessment of siting criteria, clasifications and representativeness of air quality monitoring stations

Other types of available information, e.g. photos, shall be made available through a Member State's web link.

Main emission sources (23)

Legal reference:

Decision 2011/850/EU, in ANNEX II - (D) Information on the assessment methods lists the "Main Sources" as a piece of information that MS should report, where available.

***

Contribution of a source below 3 % may be labelled not significant. The main emission source(s) can be selected from the Code list "Main Emission Sources".
The complete Code list is published at:

http://dd.eionet.europa.eu/vocabulary/aq/emissionsource/view

The Nomenclature For Reporting (NFR) has been developed under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) to ensure the standardised reporting of emission inventory data from Parties. Information on the Convention is available at:
http://www.unece.org/env/lrtap

The NFR reporting structure is closely aligned with the Common Reporting Format (CRF) used for reporting of greenhouse gases to the United Nations Framework Convention on Climate Change (UNFCCC), and takes into account additional specific air pollution sources. The NFR format is defined within the 2009 Emission Reporting Guidelines (ECE/EB.AIR/97) agreed under the Convention. These Guidelines are presently undergoing revision with finalisation expected by the end of 2013. Changes to the NFR structure and format are expected.

In addition to the NRF emission categories, two “source” types have been introduced which represent contributions not originating from identifiable sources: “Secondary” and “Long-range transport”. For both, neither a sectoral nor a spatial source attribution is possible.

Table 13 Main emission sources

Main Emission Source	**UNFCCC CRF category**	**Description**
Energy	1.A.1	1. Energy /A. Fuel Combustion /*1. Energy* Industries
Industry	1.A.2 2.	1. Energy /A. Fuel Combustion /*2. Manufacturing Industries and Construction* 2. Industrial Processes /A. Mineral Products, B. Chemical Industry, C. Metal Production, D. Other Production

Transport	1.A.3	1. Energy /A. Fuel Combustion/*3. Transport*
Domestic	1.A.4 1.A.5	1. Energy /A. Fuel Combustion/4. Other Sectors 1. Energy /A. Fuel Combustion/5. Other
Fugitive emissions	1.B	1. Energy / B. Fugitive Emissions from Fuels /*1. Solid Fuels, 2. Oil and Natural Gas*
Agriculture	4.	4. Agriculture /A. Enteric Fermentation, B. Manure Management, C. Rice Cultivation, D. Agricultural Soils, E. Prescribed Burning of Savannas, F. Field Burning of Agricultural, Residues, G. Other
Solvents	3.	3. Solvent and Other Product Use
Waste	6.	6. Waste /A. Solid Waste Disposal on Land, B. Wastre-water Handling, C. Waste Incineration, D. Other
Secondary		Secondary pollutants originating from precursors , the sources of which are distributed over a large area.
Long-range transport		Transport over distances of several 100 km, originating from sources which are distributed over a large area.
Other		

Requirements on the accuracy of coordinates (26)

Legal reference:

Decision 2011/850/EU,in ANNEX II - (D) Information on the assessment methods; point 26 lists 'Geographical coordinates: longitude, latitude and altitude of monitoring station' as information that MS should report.

***

It is recommended to give the station coordinates in degrees-minutes-seconds, with the second in one decimal, which corresponds with about 3 meters in north-south direction and 1.3 to 2.3 meters in east-west direction depending on the latitude. If the coordinates are given in degree-decimal notation, it is recommended to give this in at least four decimals (corresponding to an accuracy of about 10 meters) but preferably five decimals (corresponding to an accuracy of about 1 meter).

Member States are recommended to use the European Terrestrial Reference System 1989 or subsequent updates (substitution by the World Geodetic System 1984 is accepted for a transitional period i.e. to 2020). The spatial reference system used has to be reported.

Classification of the Area (28)

Legal reference: Decision 2011/850/EU, ANNEX II - (D) Information on the assessment methods lists the "Classification of the area" as one of the information MS should report.

***

Classification of the Area describes the location with respect to distribution/density of building. The Code list is at:

http://dd.eionet.europa.eu/vocabulary/aq/areaclassification/view

Table 14 Criteria for area classification

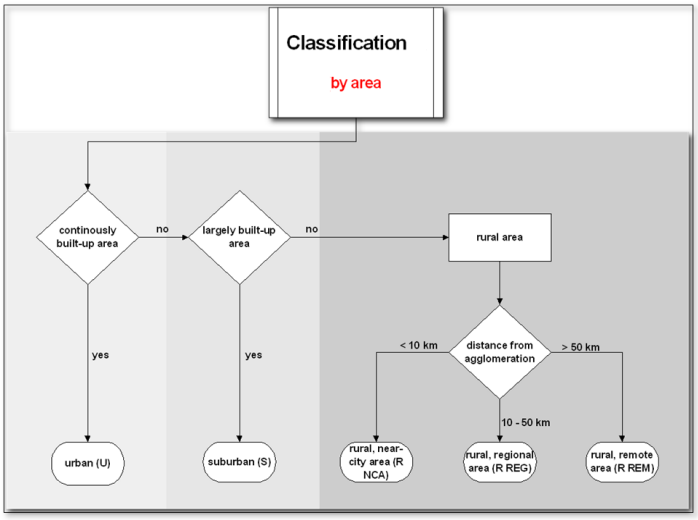
Urban area	Continuously built-up urban area meaning complete (or at least highly predominant) building-up of the street front side by buildings with at least two floors or large detached buildings with at least two floors. With the exception of city parks, large railway stations, urban motorways and motorway junctions, the built-up area is not mixed with non-urbanised areas.
Suburban area	Largely built-up urban area. 'Largely built-up' means contiguous settlement of detached buildings of any size with a building density less than for 'continuously built-up' area. The built-up area is mixed with non-urbanised areas (e.g. agricultural, lakes, woods). It must also be noted that 'suburban' as defined here has a different meaning than in every day English i.e. 'an outlying part of a city or town' suggesting that a suburban area is always associated to an urban area. In our context, a suburban area can be suburban on its own without any urban part.
Rural area	All areas, that do not fulfil the criteria for urban or suburban areas, are defined as "rural" areas. The rural area could be further subdivided to indicate the distance to the nearest built-up urban area: • Rural – near city: area within 10 km from the border of an urban or suburban area; • Rural – regional: 10-50 km from major sources/source areas; • Rural – remote: > 50 km from major sources/source areas.

The distances given here are only indicative. The border in this case should be understood as the factual delimitation of the built-up area, not the administrative border.

These definitions are based on the distribution/density of buildings. However other elements such as population density, size of the area and land-use information can be taken into consideration when classifying the area.

The different area types are mutually exclusive. A single area cannot be classified by two or more types.

Figure 2 Classification of stations in relation to the area



(ii) Indicative measurement and validation procedure

Legal reference: Decision 2011/850/EU, Article 9, paragraph 4 and Annex II D (iii)

***
Information about indicative measurement shall include at least the following:

- the measurement method applied;
- the sampling points and the coverage area;
- the validation method;
- the documentation of data quality.

Information and guidance on the use of indicative measurements can be found in the Guidance Report on Preliminary Assessment under EC Air Quality Directives (Van Aalst et al., 1998) and several more recent publications (Gerboles et al., 2005, Buzica et al., 2008, Plaisance et al., 2008, Hafkenscheid et al., 2009 etc).

Example:

Reporting the annual average of NO_2 using passive samplers [from Gerboles et al, 2005]

This is an extract from a scientific paper published in a peer reviewed journal. The work was not performed with the aim of reporting the results through the schemata. Therefore, not all the fields are appropriate in this case. Nevertheless, it is presented here as an example as regards the possible use of passive sampler as an indicative measurement. Details of some elements are described in ***Table 15*** which we believe will help Member States understand what kind of information is needed in case of using passive samplers.

Table 15 Example of Dataset D for reporting annual average of NO_2 using passive samplers

Reference	Description	Example
D.6.2	Description of the method	NO_2 Palmes diffusion tubes consists of an acrylic tube open at one end and stainless steel meshes coated with triethanolamine (TEA) at the closed end. A modification of the traditional Palmes diffusion tube by fitting a membrane at the open end of the tube is used. NO_2 diffuses through the air in the tube and is trapped as nitrite ion on TEA. It is then retained for subsequent quantitative analysis. The colorimetric method is used.
D.6.3.3	Measurement description	Passive sampler
D.6.3.3.1	Measurement type	Passive sampler (Palmes type)
D.6.3.3.2.1	Measurement method (see code list)	Other, colorimetry at 540 nm
D.6.3.3.3.1	Sampling method (see code list)	Passive adsorbent
D.6.3.3.4	Analytical technique principle	Colorimetry
D.6.3.3.4.1	Analytical technique description (see code list)	Griess-Saltzman reaction
D.6.3.4.1	Measurement /sampling	To prepare the samplers, 3 steel meshes were coated using 40 ml

	equipment	freshly prepared 10% v/v aqueous solution of TEA. A set of 6 samplers was exposed for every 2 weeks.
D.6.3.4.3	Detection limit	1.4
D.6.3.4.4	Unit of detection limit	µg/m^3
D.6.3.5	Demonstration of equivalence	Not necessary when use in zones below the upper assessment threshold. If used in the zones above the upper assessment threshold, then the demonstration of equivalence is necessary
D.6.3.5.	Equivalence with reference method demonstrated (see code list)	Equivalence demonstrated
D.6.3.5.2	Link to demonstration of equivalence report	http://publications.jrc.ec.europa.eu/repository/handle/111111111/773
D.6.3.6.1	Documentation of Traceability and Uncertainty Estimation	Estimation of uncertainty: please see chapter 5.3 Uncertainty calculation in: http://publications.jrc.ec.europa.eu/repository/handle/111111111/8170
D.6.3.6.2	Documentation of QA/QC	http://publications.jrc.ec.europa.eu/repository/handle/111111111/8170
D.6.3.7.1.1	Sampling duration unit (see code list)	week
D.6.3.7.2	Sampling interval	2 weeks

Notes:

1. Validation method (non – exhaustive list)

- Preparation of the sampler:
  To prepare the samplers, 3 steel meshes were coated using 40 ml freshly prepared 10% v/v aqueous solution of TEA.
- Method of analysis: Nitrite is extracted into aqueous solution and quantified by Saltzman reaction and colorimetric absorbtion at 540 nm.
- Determination of limit of detection: 1.4 µg/m^3
- Laboratory and field comparison with the reference method: please see the results of NO2 for Lab 1 in: http://publications.jrc.ec.europa.eu/repository/handle/111111111/10710
- Estimation of uncertainty: please see chapter 5.3 Uncertainty calculation in: http://publications.jrc.ec.europa.eu/repository/handle/111111111/8170

2. Documentation of QA/QC may contain (non – exhaustive list):

- The following QA/QC methods were introduced for preparation, cleaning and storage:
  - plastic tubes (Gradko International Ltd. DIF100) and caps (transparent XDIFCAP-001 and coloured XDIFCAP- 003) are cleaned using Millipore water and a shaker, for 3 h. The water was changed every half an hour.
  - all of the tubes and caps were placed in an oven at 45 1C until they were completely dry.

- the stainless steel mesh discs (XDISC) were cleaned in an ultrasonic bath at 60 1C changing the water ten times at intervals of 30 min. The meshes were then dried in an oven at 125 °C under a stream of nitrogen.

- A link to the internal SOP Standard Operational Procedure for preparation, analysis and reporting the results could be made available.

- The chemical analyses are performed using high quality chemical reagents; the calibration curve is checked by using standard check at the beginning, in the middle and at the end of each series of analysis.

(iii) Modelling information and validation procedure

Legal reference : Decision 2011/850/EU, Article 9, paragraph 5 and Annex II D (iv)

***

Information about modelling shall include at least the following:
- the description of the modelling system and its inputs;
- the model validation through measurements;
- the coverage area;
- the documentation of data quality.

The EU Forum for AIR quality MODelling (FAIRMODE) (http://fairmode.ew.eea.europa.eu/) has developed guidelines which can be found in "The application of models under the European Union's Air Quality Directive: A technical reference guide", available at:

http://www.eea.europa.eu/publications/fairmode

Models are important assessment techniques that can help in assessing pollution levels throughout MS. They need to be configured to assess levels in the locations specified in Annex III of the AAQD. When used in conjunction with measurements to assess attainment of limit and target values the assessment shall be:

- based on the highest observed or predicted concentration i.e. either the maximum measured or maximum modelled in each zone,
- model outputs must be relevant to the assessment requirements in Annex III of the AAQD.

Highest concentration in a zone will typically be at traffic locations (or alternatively at some industrial locations) but not including locations where the public do not have access and not including within 25 metres of major junctions. Urban background locations are typically representative of exposure of the general population over several square km.

Example

Reporting of modelling results in the UK case – examples of XML content for datasets D and E are presented in Table ***16*** .

Table 16 Example of Dataset D for reporting the UK modelling results

Element	Requirement in IPR	Explanation	Example
D.7.1	Modelling ID	Identifier	Modelling ID shall include country code and pollutant AirBase code
A.8.1	localID	Text	A unique identifier for the element. A description of what is to go in the localID will be given where the identifier datatype is used.
A.8.2	namespace	Text	http://uk-air.defra.gov.uk/e-reporting/aq/2013-beta/
A.8.3	versionID	Text	Version 1
D7.2.1	Name	Short text to name your model	Pollution Climate Mapping (PCM) model
D7.2.2	Description	Short text to describe how your model works.	GIS-based dispersion kernel model for background locations at 1x1km resolution, calibrated with monitoring. Empirical increment model for roadside concentrations, calibrated with monitoring.
D7.2.3	Documentation	Link to where more detail on your model can be found.	http://uk-air.defra.gov.uk/reports/cat09/1204301513_AQD2010mapsrep_master_v0.pdf
A1	Body responsible for modelling	Either the competent authority for assessment, or the organisation running the model.	Department for Environment Food and Rural Affairs Joe Bloggs Area 5E Ergon House 17 Smith Square London SW1P 3JR http://www.defra.gov.uk/environment/quality/air/air-quality/ +44 (0) 207 238 6951 Joe.bloggs@defra.gsi.gov.uk
A3.1	Environmental Objective type	Choose from code list Environmental Objective Type	http://dd.eionet.europa.eu/vocabulary/aq/objectivetype/LV
A3.2	Reporting metric	Choose from code list Reporting metric	http://dd.eionet.europa.eu/vocabulary/aq/reportingmetric/aMean
A3.3	Protection target	Choose from code list Protection Target	http://dd.eionet.europa.eu/vocabulary/aq/protectiontarget/H
D7.2.6	Area of modelling – Spatial Extent	GIS description of the extent of the model	A GML encoding or shape file of the limit (extent or boundary) of the model domain.
D7.3.1	Model time resolution		
D7.3.1.1	Time unit	Choose from code list Time unit	http://dd.eionet.europa.eu/vocabulary/aq/timeunit/year
D7.3.1.2	Number of time units	Number	1
D7.3.2	Modelling Period	Description of the time period model data are provided for	
D7.3.2.1	Modelling start date		2012-01-01T00:00:00Z

Element	Requirement in IPR	Explanation	Example
D7.3.2.2	Modelling end date		2012-12-31T24:00:00Z
D.7.4	Spatial resolution	Resolution of the data provided in the model instance.	1 x 1 km for background at locations, 5 m at roadside locations.
D.7.5.1	Data quality objectives: Documentation of traceability and uncertainty estimation	Text to describe how traceability and uncertainty calculations have been carried out.	In the absence of standardised approach to the determination of model uncertainty, calculations have been undertaken showing the number of data points for which the maximum deviation of the modelled and measured concentration meets the data quality objectives specified in the ambient air quality directives. This shows that at least 90% of the data points lie within the data quality objective (e.g. 30% for annual mean NO2, or 50% for annual mean PM10) of the observed values, taking into account the requirement to do this calculation for concentration values in the vicinity of the LV and using stations which are representative of the spatial resolution of the model. Model verification and evaluation using observation stations has been undertaken as described in the URL provided, using the stations linked to and listed in the datasets..
D.7.5.2	Data quality objectives: Link to report which documents all QA/QC	Link to report	http://uk-air.defra.gov.uk/reports/cat09/1204301513_AQD2010mapsrep_master_v0.pdf
D.7.6.1	Standard Databases	See code list Reporting Level, multiple entries accepted	INSPIRE code list to be provided
D.7.6.2	Other Databases	If data is provided to databases not in the list, please select “Other specify” and then enter this database in the Text field.	None
D.7.7	Organisation Level	The organisational level this model covers. Values from the INSPIRE code list LegislationLevelValue; possible values are international, European, national, sub-national	National
D.7.8	Media Monitored	Menu	Air

Table 17 Example of Dataset E for reporting the UK modelling results

Element	**Requirement in IPR**	**Explanation**	**Example**
E.1	Primary data report identifier	Identifier	Unique identifier for the Primary data report, which includes the version number.
A.8.1	localID	Text	A unique identifier for the element. A description of what is to go in the localID will be given where the identifier datatype is used.
A.8.2	namespace	Text	http://uk-air.defra.gov.uk/e-reporting/aq/2013-beta/
A.8.3	versionID	Text	Version 1
E.2	Provider	Contact Details	Department for Environment Food and Rural Affairs Joe Bloggs Area 5E Ergon House 17 Smith Square London SW1P 3JR http://www.defra.gov.uk/environment/quality/air/air-quality/ +44 (0) 207 238 6951 Joe.bloggs@defra.gsi.gov.uk
E.3.	*Change description*	*Documentation of change*	Any textual description
A.7.1	Change	Boolean	"true" if changes to previous submission, otherwise "false"
A.7.2	Description of change	Text	Revision to previously submitted model run to update meteorological parameters.
E.4.1	Assessment Result Identifier	Identifier	An identifier for the assessment results. In the case of final assessment data this should be a unique identifier used for only one submission. In the case of near real time data the identifier can be reused
E.4.2	Pollutant	Menu	http://dd.eionet.europa.eu/vocabularyconcept/aq/pollutant/8
E.4.3	Assessment Type	Menu	http://dd.eionet.europa.eu/vocabulary/aq/assessmenttype/model
E.4.4	Assessment method	Menu	http://uk-air.defra.gov.uk/e-reporting/aq/2013-beta/D_GB_Model_Metadata.xml#Model_GB1
E.4.5	*Time period of dataset*		*Start and end timestamp of values covered by this dataset for this pollutant and assessment type*
E.4.5.1	Start of dataset	Timestamp	Start of values covered by this dataset for this pollutant and assessment.
E.4.5.2	End of dataset	Timestamp	End of values covered by this dataset for this pollutant and assessment.
E.5.1	Start of value	Timestamp	2012-01-01T00:00:00Z
E.5.2	End of value	Timestamp	2012-12-31T24:00:00Z
E.6.1	Unit of pollutant	Menu	http://dd.eionet.europa.eu/vocabularyconcept/aq/observationunit/ug.m-3

Element	**Requirement in IPR**	**Explanation**	**Example**
E.6.2	Measurement Value	Number	Measurement results from monitoring or indicative measurement
E.6.3	Modelled Value	Spatial Observation	http://uk-air.defra.gov.uk/e-reporting/aq/2013/roadside_model_predictions.shp or http://uk-air.defra.gov.uk/e-reporting/aq/2013/background_model_concenhtrations.asc or http://uk-air.defra.gov.uk/e-reporting/aq/2013/background_model_concenhtrations.nc
E.6.4	Validity	Menu	Not mandatory for modelling / objective estimation
E.6.5	Verification status	Menu	Not mandatory for modelling / objective estimation
E.7.1	Data Quality Objective: Time Coverage	Boolean	True
E.7.2	Data Quality Objective: Data Capture	Boolean	True
E.7.3	Data Quality Objective: Uncertainty Estimation	Number	< +/- 25%*
E.8.1.1	Modelling method: calibration by measurement	Link	http://some_URL_to_a/metadata_file_for_fixedstations.csml#GB_SamplingPoint_25 http://some_URL_to_a/metadata_file_for_fixedstations.csml#GB_SamplingPoint_26 http://some_URL_to_a/metadata_file_for_fixedstations.csml#GB_SamplingPoint_27
E.8.1.2	Modelling method - calibration by measurement at sites not operated under the AQD	Text	Measurements / observation from sampling point operated by Acme Inc. were included in the model calibration. These observations and station metadata are not in the public domain for commercial reasons.
E.8.2.1	Modelling method: verification by measurement	Link	As in E8.1.1
E.8.2.2	Modelling method - verification by measurement at sites not operated under the AQD	Text	As in E8.1.2

* Uncertainty Estimation modelling, until methods to calculate uncertainty are agreed by FAIRMODE, it will not be possible to report uncertainty according to the formats specified by the schema (which requires a numeric value). Current practice is to provide an analysis of whether uncertainty is less than ≤ ±25%, this is documented in D7.2.3.

(iv) Objective estimation

Legal reference: Decision 2011/850/EU, Article 9, paragraph 6 and Annex II D (v)

***

Information about objective estimation shall include at least the following:
- the description of the estimation method;
- the documentation of data quality.

"Objective estimation techniques" will be interpreted as mathematical methods to calculate concentrations from values measured at other locations and/or times, based on scientific knowledge of the concentration distribution. One example is linear interpolation based on a justified assumption that the concentration pattern is sufficiently smooth. Another example is a dispersion model that has been adjusted to reproduce concentrations measured within its domain. More information is available at: http://ec.europa.eu/environment/air/pdf/guidanceunderairquality.pdf)

Example

The same example as for modelling could be used in the case of objective estimation (see Reporting of modelling results in the UK case – examples of XML content for datasets D and E).

(v) Data quality and traceability

Legal reference: Decision 2011/850/EU Annex II D (ii)-(v) all include data quality information as information to be reported by MSs.

***

All requirements for data quality and traceability laid down in directives 2008/50/EC Annex I and 2004/107/EC Annex IV are directly applicable to the assessment procedures implemented by Member States. Data quality objectives are to be reported for each measurement configuration.
With reference to requirements for data quality and traceability as set out by Annex II D (ii)-(v) of the Decision, these have been modified for the implementation of reporting mechanisms. Data quality and traceability as set out by Annex II D (ii)-(v) now form part of the data flows set out by Annex II E and F - data quality and traceability being properties of primary and aggregated data. Thus, the data quality objectives i.e. measurement uncertainty, data capture and data coverage will be reported with the measurement configurations in Dataset E (Primary data) and F (Aggregated data) whilst information on the limit of detection in Dataset D (Information about assessment methods).

In addition, quality assurance is documented by flagging individual measurements data according to their validation status (see also E (ii) Validity flag and verification status flag).

Note:
The issue of estimating and reporting the measurement uncertainty is to be dealt with by AQUILA. As soon as their recommendation on the calculation/reporting of measurement uncertainty is ready, it will be added to this guidance.

(E) Information on primary validated assessment data and primary up-to-date assessment data (Article 10)

General principles

(i) Averaging times

Legal reference:

Decision 2011/850/EU, Article 2 provides the following definitions:
(7) 'primary data' means information on the concentration or deposition level of a specific pollutant at the highest time resolution considered in this Decision;
(8) 'primary up-to-date assessment data' means primary data collected with the frequency appropriate to each pollutant assessment method and made available to the public without delay.

***

All measurement values reported as primary data or primary up-to-date data shall be reported at the highest time resolution considered appropriate in relation to the environmental objectives stated in the Directives.

For gaseous pollutants the averaging time for measurements is usually one hour. In some cases, where Member States record raw data obtained by automatic monitors as half hour mean values, these data should be used to calculate the hourly mean values before transmitting.

In the case of PM_{10} or $PM_{2.5}$, 24-hour mean values are obtained by using the gravimetric reference method described in EN12341. These data are transmitted as daily values. However, if automatic monitors (beta-absorption, tapered element oscillating microbalance (TEOM), etc.) are used, raw data with a resolution of 30 minutes or one hour are usually available. These data could be aggregated to hourly averages for reporting and subsequently aggregated to 24-hour mean values. However, if both of them are reported then the daily data will be ignored. All PM data reported, both up to date as well as validated values shall be reported as equivalent to the reference method for fixed measurement purposes. In the case of indicative measurements, the data should be supplied with a correction factor where this is required. PM can be reported without applying the correction factor only for Exchange of Information and objective estimations purposes.

Some measurement techniques involve sampling times from a few minutes to a period of several weeks. In such a case values with variable averaging times shall be reported indicating the actual averaging period.

Non-automatic sampler based techniques measured components (e.g. benzene, the components from the 4th Daughter Directive (heavy metals and PAH) may use a variety of sample averaging times e.g.: 1-week, 2-week, 4-week, 1-month, 3-month, year, variable (varying sampling times). These measurements consist of samples with a start date/time and an end date/time. The averaging time of the sample is the period of the sample (end date/time minus start date/time).

(ii) Validity flag and verification status flag

Legal reference: Decision 2011/850/EU Annex II E points 12 and 13; note, also applicable for Annex II F points 14 and 15.

***

Validity and verification flags shall be used for the primary validated assessment data and primary up – to –date assessment data, reported with dataset E.

Validity flags are
1: valid
2: Valid, but below detection limit measurement value given
3: Valid, but below detection limit and number replaced by 0.5*detection limit
-99: not valid due to station maintenance or calibration
-1: Not valid due to other circumstances or data is simply missing.

See also:
http://dd.eionet.europa.eu/vocabulary/aq/observationvalidity/view

Verification flags are

1: verified
2: preliminary verified
3: not verified

See also:
http://dd.eionet.europa.eu/vocabulary/aq/observationverification

Other issues

Handling of values below the detection limit

Legal reference: None.

***

For all measurements, basic values which are greater than or equal to the negative detection limit (–DL, i.e. the negative value of the detection limit) shall be accepted as they are and used for further evaluations and in all aggregations and calculations.
Values smaller than the negative detection limit, shall be discarded. Only in cases where values which are greater than or equal to the negative detection limit but lower than the detection (or quantification, if available) limit are not accessible, these values shall be replaced by half the detection (or quantification, if available) limit and flagged.

Example

The detection limit is 2 µg/m³. A value of -3.1 µg/m³ is below the negative detection limit and has to be discarded. A value of -2µg/m³ is equal to the negative detection limit and therefore has to be considered as a valid measurement value (validity flag = 2, i.e. value below detection limit but measurement value given).

Discussions about two alternatives could arise in the case of -2.1 µg/m³:
1) -2.1 is smaller than -2 , so the value has to be discarded (validity flag = -1);
2) -2.1 is rounded to -2 and therefore equal to the detection limit, so the value has to be considered as a valid measurement value (validity flag = 2);
The correct answer is that the value is rounded with one decimal place (1≤|-2.1|<10, see **(2) Number of significant digits and rounding**) and has to be discarded (option 1).

These provisions generally apply for all kinds of measurements. The rounding should be done according to the commercial rounding rules.
The only exceptions are some continuous PM monitoring techniques where negative values below the negative DL have a physical reason and shall therefore not be discarded in the course of data validation. Such values are to be considered as valid measurement values with a validity flag = 2.

The above rules were drawn by AQUILA and could be found at:
http://ies.jrc.ec.europa.eu/uploads/aquila/N%20143%20revised%20Recommendations%20AQUILA%2013th%20meeting%2016_03_2011.pdf

(F) Information on generated aggregated data and statistics (Article 11)

This section provides a description of the rules for calculation of aggregations and statistical values that are applied by the e-Reporting system. The calculations are made on all primary data that is reported (i.e. for all stations and measurement configurations and can even be applied to modelled data), irrespective of data capture rates (the proportion of valid data available, see section (iii) below). All statistics are however accompanied by an associated time coverage and data capture rate. It is recommended to report data and calculate statistics in the officially adopted local time zone for the territory (except for AOT40 which refers to CET). Member States may also choose to report in another geographical time zone applicable to their territory. In all cases where time units are to be reported, the extended ISO 8601 format shall be used. In some cases, the use of CET is not appropriate, e.g. for Caribbean islands. In such cases the local time shall be used for calculation for the ozone environmental objective (e.g. AOT 40). In all cases, Member States must declare the time zone used for the aggregation.

(i) Pollutants and their reporting metrics

Table 18 indicates for each of the main pollutants, which parameters can be calculated from which base data. The parameters in question include the percentiles corresponding to the relevant limit values.

Table 18 Pollutants and their reporting metrics

Component	Parameter based on			
	Hourly values, if reported	Daily values, if reported (raw daily & aggregated daily)	Daily maximum 8-hour running mean (aggregated from hourly)	Non hourly/daily (sample) data

Sulphur dioxide (SO_2)	- annual mean - hours with c > 350 μg/m^3 - 99.73 percentile* (~ max. 25 h) - hours with c > 500 μg/m^3 - winter mean	- annual mean* - days with c > 125 μg/m^3 - 99.2 percentile* (~ max. 4 days) - winter mean		- annual mean
Nitrogen dioxide (NO_2)	- annual mean - hours with c > 200 μg/m^3 - 99.79 percentile* (~ max. 19 h) - hours with c > 400 μg/m^3	- annual mean*		- annual mean
Nitrogen oxides (NO_x)	- annual mean	- annual mean*		
Ozone (O_3)	- hours with c > 180 μg/m^3 - hours with c > 240 μg/m^3 - AOT40 - AOT40 averaged over 5 years		- days with c >120 μg/m^3 - 93.2 percentile* (~ max. 26 days) - days with c >120 μg/m^3 averaged over 3 years	- annual mean
Carbon monoxide (CO)			- days with c >10 mg/m^3 maximum 8-hour running mean	
Particulate matter (PM_{10})	- annual mean	- annual mean - days with c > 50 μg/m^3, - 90.4 percentile (~ max. 36 days)		- annual mean*
Particulate matter ($PM_{2.5}$)	- annual mean	- annual mean AEI** NERT**		- annual mean*
All other pollutants	- annual mean	- annual mean		- annual mean

(*) Not to be used for compliance checking.

(**) As described in the appropriate chapters of this Guidance.

(ii) Data aggregation

Legal reference:

Directive 2008/50/EC defines in Annex XI.A and Annex VII.A the aggregation rules for the pollutant to be reported. Annex I of the same Directive and Directive 2004/107/EC, Annex IV define the data quality objectives for the pollutant to be reported for ambient air quality assessment.

***

Base aggregations on primary hourly and daily data are to be carried out using the methods detailed below. Data aggregation has to be performed before rounding. Data shall therefore always be reported with the same number of digits as when obtained and processed in the monitoring network. The following aggregation flags are used to indicate the validity of aggregated data:

1: valid
-1: not valid due to insufficient valid data in the averaging period

The code list can be found at: http://dd.eionet.europa.eu/vocabulary/aq/aggregatevalidity/view

The minimum time average that data shall be reported in is hourly. Rules are thus not provided for the calculation of hourly values. Any values with a higher time resolution than one hour shall be aggregated to hourly values by the Member States before reporting. This aggregation shall be done according to the criteria provided in section A.2. of Annex VII and section A of Annex XI (i.e. a minimum of 75% (45 minutes) is required for a valid one hour value).
Data aggregation has to be performed before rounding.

All rules described in this guidance shall be applied using the routines made available by the EEA through the portal.

(iii) Time coverage and data capture

(a) Hourly and daily values

Legal reference:

Section A, Annex I of Directive 2008/50/EC and section I, Annex IV of Directive 2004/107/EC provides data quality objectives for ambient air quality assessment. For fixed and indicative measurements these objectives include minimum time coverage and minimum data capture. It is also stated that these requirements do not include losses of data due to the regular calibration or the normal maintenance of the instrumentation.

***
Definitions: Time coverage and data capture are defined as follows:

> *Time coverage:* Proportion (%) of a calendar year (or summer season (April - September) in the case of indicative ozone measurements), for which measurements were originally planned. **This shall not be less than the minimum time coverage requirements set out in Section A of Annex I in the Directive 2008/50/EC and section I, Annex IV of Directive 2004/107/EC.**
>
> *Data capture:* Proportion (%) of valid measurements obtained within the measurement period defined by time coverage. For ozone measurements, the measurement period must be divided into summer and winter seasons.

Time coverage

For many pollutants, minimum time coverage requirements for fixed measurements are not explicitly provided. This is because fixed measurements of these pollutants are required to be continuous throughout a calendar year. In practice this provides an implicit minimum time coverage

requirement of 100%. For all other measurements, minimum time coverage requirements are provided as percentages.

Time coverage for "continuous" fixed measurements (i.e. those that are subject to the implicit minimum time coverage requirement of 100%) **shall be reported as 100% in all cases**. For all other measurements the default time coverage for a given measurement will be the relevant minimum time coverage requirement provided in Section A of Annex I in Directive 2008/50/EC or Section I of Annex IV in Directive 2004/107/EC. In the case that the planned measurement period exceeds the relevant minimum time coverage requirement, this shall be reported instead.
In order to calculate time coverage from the planned measurement time, the following formula shall be used:

$$\text{Time coverage} = 100 * N_{planned} / N_{year} \%$$

where

$N_{planned}$ is the number of days/hours on which measurements were planned to take place and N_{year} is the total number of days/hours in the calendar year. (N.B. for indicative measurements of ozone, this calculation shall be done only for the summer season, i.e. $N_{planned}$ shall only consider planned measurement time during the summer season and N_{summer} shall replace N_{year}, and is the total number of days/hours in the summer season)

Where a measurement method delivers hourly values, $N_{planned}$ and N_{year} shall be calculated using number of hours. Where a measurement method delivers daily values, $N_{planned}$ and N_{year} shall be calculated using number of days.

Examples:

The examples below illustrate the potential options for reporting time coverage for indicative measurements of NO_2:

Minimum time coverage requirement = **14%** (can be reported as time coverage by default)

Where measurements are planned once per week (i.e. 52 days a year):

Time coverage = 100*52/365 = **14.25%**

Where measurements are planned twice per week (i.e. 104 days a year):

Time coverage = 100*104/365 = **28.49%**

Note: Where time coverage is calculated from planned measurement time, this should be reported with two decimal places. This provides greater accuracy in any subsequent calculation of data capture.

The reported time coverage defines the measurement period that is subsequently used in the calculation of data capture provided below. All data losses within this measurement period are taken into account in the calculation of data capture.

Data capture

The requirements for minimum data capture are provided as percentages for all measurements. The data capture for a measurement can be calculated using the following formula:

Data capture (%) = 100 * N_{valid}/N_{total} %

where N_{valid} is the number of valid hourly/daily measurements in the measurement period (defined by time coverage) and N_{total} is the total number of hours/days in that measurement period. (N.b. the measurement period for ozone measurements must be divided into summer and winter seasons).

Where a measurement method delivers hourly values, N_{valid} and N_{total} shall be calculated using number of hours. Where a measurement method delivers daily values, N_{valid} and N_{total} shall be calculated using number of days.

Where the "default" time coverage is reported (i.e. the minimum time coverage requirement), N_{total} is equal to the number of hours/days provided in the table below.

Where the reported time coverage is the planned measurement period, N_{total} is equal to $N_{planned}$.

Table 19 Number of hourly/daily values in the periods corresponding to the minimum requirement for time coverage

	Normal year		**Leap year**	
Percentage of the year (or season) (%)	**N_{total} (hourly values)[1]**	**N_{total} (daily values)**	**N_{total} (hourly values)[1]**	**N_{total} (daily values)**
100	8760	365	8784	366
100 - summer (O_3, Apr. – Sept.)	4392	183	4392	183
100 – winter (O_3, Jan-March + Oct-Dec)	4368	182	4392	183
90 (Benzene, industrial)	7896	329	7920	330
35 (Benzene, urban background and traffic)	3072	128	3096	129
33 (BaP)	N/A[2]	121	N/A[2]	121
50 (As, Cd, Ni)	N/A[2]	183	N/A[2]	183
14 (indicative measurement)	1248	52	1248	52
>10 (O_3, indicative measurement, summer)	456	19	456	19

[1] N_{total} (hourly values) has been calculated as 24 * N_{total} (daily values), and assumes that it is always planned to carry out a full day's (or 24 consecutive hours) monitoring.
[2] Hourly values are not applicable for BaP, As, Cd and Ni, since the measurement methods for these pollutants normally deliver daily (24 hour) values and values at other time resolutions (e.g. weekly, monthly, var etc).

Note:
Footnote (1) to the table in section A, Annex I of Directive 2008/50/EC and the final paragraph of section I, Annex IV of Directive 2004/107/EC allow for lower minimum time coverage requirements for some measurements, provided that given requirements regarding uncertainty are met. Where this provision is applied, the calculations described above shall be adjusted accordingly.

Checking for compliance with the data quality objectives

As stated previously, time coverage shall not be less than the minimum time coverage requirements set out in Section A of Annex I in the Directive and Annex IV of 2004/107/EC. The data quality objective for minimum time coverage will therefore be met in all cases. The validity of measurements with regard to these data quality objectives is thus checked using only data capture.

Data capture shall be rounded immediately before being compared with the minimum data capture requirement, following the so-called commercial rounding rules (see section **(2) Number of significant digits and rounding**). The data quality objective for data capture and time coverage is considered to be met if:

Data capture (%)(after rounding) ≥ Minimum requirement

Since the directive states that requirements for minimum data capture and time coverage do not include losses of data due to the regular calibration or the normal maintenance of the instrumentation, an adjustment needs to be made to the requirement for minimum data capture before checking whether this requirement is met.

According to the "Guidance on the Annexes to Decision 97/101/EC on Exchange of Information as revised by Decision 2001/752/EC", 5% is a good general approximation of the proportion of measurement time in a calendar year dedicated to planned equipment maintenance and calibration. This was also confirmed in several meetings of EIONET in 2008.

It is therefore possible to take account of data losses due to what is considered to be a reasonable amount of time for regular maintenance, by reducing the data quality objective for minimum data capture by 5%.

Note:
On a natural interpretation of the 'loss of data' provision, it could be held that the 5% data loss would be deducted from the time coverage, and the required data capture calculated as the data capture quality objective (say 90%) multiplied by the new time coverage. However, in practice the difference between that approach, and simply deducting 5% from the data capture, is small, and as the latter is simpler it is recommended on pragmatic grounds.

The data quality objective for minimum data capture to be used for compliance checking should therefore be taken as 85% instead of 90% for all measurements, with the exception of ozone measurements during the winter, where the data quality objective for minimum data capture should be taken as 70% instead of 75%.

Examples

Some examples of the calculation of data capture and of subsequent compliance checking are given below. The validity status refers to the attainment of the data quality objective for minimum data capture:

1) Fixed measurement of NO2 (hourly values)

Time coverage = 100% → N_{total} = 8760 hours
N_{valid} = 8199 hours
Data capture = 100 * 8199 / 8760 = 93.6% (rounded to 94%)

data capture (94%) > minimum data capture (85%) → measurement is valid

2) Fixed measurement of ozone (hourly values)

Time coverage = 100% → $N_{total\ summer}$ = 4392 hours, $N_{total\ winter}$ = 4368 hours
N_{valid_summer} = 3420 hours ; N_{valid_winter} = 3950 hours
Data capture summer = 100 *3420 / 4392 = 77.9% (rounded to78%)
data capture (78%) < minimum data capture for summer (85%)
Data capture winter = 100 * 3950 / 4368 = 90.4% (rounded to 90%)
data capture (90%) > minimum data capture for winter (70%)
→ measurement is not valid (minimum data capture must be achieved for both summer and winter periods)

3) Fixed measurement of benzene (hourly values), industrial site - Leap year

Minimum time coverage requirement = 90%
Planned measurement time ($N_{planned}$) = 8784 hours
Planned measurement time > minimum time coverage requirement → $N_{planned}$ used to calculate time coverage:
Time coverage = 100%
N_{valid} = 8410 hours
Data capture = 100 * 8410 / 8784 = 95.7% (rounded to 96%)
data capture (96%) > min data capture (85%) → measurement is valid

4) Fixed measurements of Benzo(a)pyrene (daily values)

Minimum time coverage requirement = 33%
Planned measurement time ($N_{planned}$) = 156 days
Planned measurement time > minimum time coverage requirement → $N_{planned}$ used to calculate time coverage:
Time coverage = 100 * 156 / 365 = 42.74%
N_{valid} = 132 days
Data capture = 100 * 132 / 156 = 84.6% (rounded to 85%)
data capture (85%) = min data capture (85%) → measurement is valid

5) Fixed measurements of Benzo(a)pyrene (daily values)

Same time coverage as in example 4 (i.e. 42.74%)
N_{valid} = 125 days
Data capture = 100 * 125 / 156 = 80.1% (rounded to 80%)
data capture (80%) < min data capture (85%) → measurement is not valid

6) Indicative measurement of PM10 (daily values)

Time coverage = 14% → N_{total} = 52 days
N_{valid} = 40 days
Data capture = 100 * 40 / 52 = 76.9% (rounded to 77%)
data capture (77%) < min data capture (85%) → measurement is not valid

7) Indicative measurement of ozone (Hourly values, summer season)

Minimum time coverage requirement = >10% during summer
Planned measurement time ($N_{planned}$) = 504 hours (21 days)
Planned measurement time > minimum time coverage requirement → $N_{planned}$ used to calculate time coverage:
Time coverage = 100 * 504 / 4392 = 11.48%
N_{valid} = 472 hours
Data capture = 100 * 472 / 504 = 93.7% (rounded to 94%)
data capture (94%) > min data capture (85%) → measurement is valid

(b) Sampling data covering several days/weeks

This section relates to the reporting of time coverage and data capture for measurements with longer sampling times, e.g. several days/weeks.
The same definitions apply.

Time coverage

The same provisions apply as for hourly and daily values. Where $N_{planned}$ is used to calculate time coverage, it is equal to the number of hours or days within the planned measurement period. In case of sampling periods covering parts of two years, this number refers to the fraction of the planned measurement period within the respective calendar year.

Data capture

Data capture can be calculated using the following formula:

Data capture (%) = 100 * $\sum_{i=1}^{n}(N_{valid,i}) \; / \; N_{total}$

where i=1 to i=n are the n valid sampling periods over which data are integrated; $N_{valid,i}$ is the number of hours/days in the sampling period i, during which valid measurement occurred; if this sampling period covers parts of two years, $N_{valid,i}$ refers to the fraction of the sampling period i within the respective calendar year; N_{total} is the total number of hours/days in the measurement period defined by time coverage. (N.b. the measurement period for ozone measurements must be divided into summer and winter seasons)

Compliance checking

The same process shall be used for compliance checking as is described for hourly/daily values.

Examples

Some examples of the calculation of data capture and of subsequent compliance checking are given below. The validity status refers to the attainment of minimum data capture:

1) Indicative measurement of NO_2 (weekly average data obtained from passive sampling)

Minimum time coverage requirement =14%
Planned measurement time ($N_{planned}$) = 56 days (8 weeks evenly distributed over the year)
Planned measurement time > minimum time coverage requirement → $N_{planned}$ used to calculate time coverage:

Time coverage = 100 * 56 /365 = 15.34%
7 valid samples out of 8
$N_{valid,1}$ ... $N_{valid,7}$ are derived from the start and end of each sampling period.
($N_{valid,1}$ ... $N_{valid,7}$) = (7,7,7,7,7,6.5,7) days
Data capture = 100 * 48.5 / 56 = 86.6% (rounded to 87%)
data capture (87%) > min data capture (85%) → measurement is valid

2) Fixed measurement of heavy metals. Pooled samples.

Minimum time coverage requirement =50%
Planned measurement time ($N_{planned}$) = 365 days
Planned measurement time > minimum time coverage requirement → $N_{planned}$ used to calculated time coverage:
Time coverage = 100 %
Daily measurements averaged over each month
$N_{valid,1}$ ... $N_{valid,12}$ are derived from the start and end of each sampling period.
($N_{valid,1}$ ... $N_{valid,12}$) = (31,28,22,12,31,30,31,31,28,20,30,31) days
Data capture = 100 *325 /365 = 89.0% (rounded to 89%)
data capture (89%) > min data capture (85%) → measurement is valid

(iv) Annual mean

Legal reference:

- annual meanDirective 2008/50/EC at Annex XI A

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The annual mean is the average of all valid hourly/daily values for a calendar year. The requirements for the calculation of the annual mean are in line with the requirements for minimum data capture. It shall thus be considered that the minimum proportion of valid data for calculating the annual mean is attained if the data quality objective for minimum data capture is met.

The annual mean can be calculated using the following formula:

$$\text{Annual mean} = \Sigma_i C_i / N_{valid}$$

where C_i is the valid hourly/daily concentration and the summation is over all valid hourly/daily values measured in the year; N_{valid} is the total number of valid hourly/daily values in the year.
The annual mean is calculated from the data series with the highest time resolution, for example, when both hourly and daily values are available the annual mean is calculated from the hourly data.

Note
Rules to calculate the three years-averaged ozone target value for protection of human health:

- If the three year average 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 valid data for at least one year.

- The one year statistics will be used in the three years average if there is at least 85% of minimum data capture in summer season and 70% of minimum data capture in winter season.

- The three year average has to be rounded to the nearest integer.

Annual mean where sampling data are integrated over several days/weeks

Legal reference: Directive 2008/50/EC, Annex I and Directive 2004/107/EC, Annex IV.

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The averaging times for some components where non-automatic measurements are applied (e.g., benzene, the components from the 4th Daughter Directive i.e. heavy metals and PAHs) have averaging times other than hourly or daily averages e.g.1- week, 2-week, 4-week, month, 3-month, year, var, etc.). Annual means for data which is not hourly or daily must be calculated using a different methodology, described below. The time references of these measurements data has to be provided with start and end data/time.

The 100% period for a n-day/n-week/n-month sample is defined as the period starting from the start date/time of the sample and ending on the same day number and time n-days/n-weeks/n-months later.

Examples

1) the sample starts at 5 March at 00:00, the 100% 1-month period is until 5 April at 00:00;
2) the sample starts at 30 January at 00:00, the 100% 1-month period would be until "virtual" 30 February, which is actually 2 March at 00:00 (no leap year).

The only statistics calculated for these averaging times is the annual mean.

Note:
Multi–hour (n-hour) values are aggregated into daily values. The derived statistics are based on these daily values.

All statistics calculations are done in analogy to the hourly/daily statistics calculations. The only exception is the data capture calculation (see (b) Sampling data covering several days/weeks) and the annual mean calculation.

The annual means are calculated according to the formula:

Annual mean = $\Sigma_i N_i C_i / \Sigma_i N_i$

where C_i is the concentration in the valid sample period i and N_i is the number of hours in sample period i. The summation is over all valid sample periods in the year.

Note:
1) If a period is partially outside the year, only the hours/day between 1 January and 31 December of the year are taken into account.
2) When the sampling time is across two calendar years, the sampling time refers to the time in the current reporting year only.

Example

Applying this formula to the following example of arsenic measured in particulate matter samples collected daily but analysed monthly
where:

Weighted concentration = $\Sigma_i N_i C_i / \Sigma N_i$

N_i = Valid data (data capture) in month (Y_i) times number of days in each month (Z_i), i.e. $N_i = Y_i.Z_i$ (for Validity flag = 1 or 2 or 3).

Table 20 Calculation of annual mean for a series of arsenic

Start of sampling period	End of sampling period	Measured concentration ng/m3 (C)	Validity flag	Valid data in month (data capture) (%) (Y)	Days in month (Z)	Valid sampling time each month (N)	Concentration x valid sampling time (ng/m3)
2010-12-31 T240000+01	2011-01-31 T240000+01	3.90532	1	100	31	31.0000	121.0649
2011-01-31 T240000+01	2011-02-28 T240000+01	1.40378	1	100	28	28.0000	39.30584
2011-02-28 T240000+01	2011-03-31 T240000+01	0.976502	1	70.97	31	22.0007	21.48373
2011-03-31 T240000+01	2011-04-30 T240000+01	0.129041	1	40	30	12.0000	1.548492
2011-04-30 T240000+01	2011-05-31 T240000+01	0.078314	1	100	31	31.0000	2.427734
2011-05-31 T240000+01	2011-06-30 T240000+01	0.088956	1	100	30	30.0000	2.66868
2011-06-30 T240000+01	2011-07-31 T240000+01	0.077084	1	100	31	31.0000	2.389604
2011-07-31 T240000+01	2011-08-31 T240000+01	0.140637	1	100	31	31.0000	4.359747
2011-08-31 T240000+01	2011-09-30 T240000+01	0.070045	1	93.33	30	27.9990	1.96119
2011-09-30 T240000+01	2011-10-31 T240000+01	0.338542	1	64.52	31	20.0012	6.771246
2011-10-31 T240000+01	2011-11-30 T240000+01	1.41943	1	100	30	30.0000	42.5829
2011-11-30 T240000+01	2011-12-31 T240000+01	1.09143	1	100	31	31.0000	33.83433
	Sum					325.0009	280.3984
	Annual mean						0.862762

(v) Daily mean

Legal reference:

Directive 2008/50/EC, ANNEX XI defines an averaging period of "one day".

***

The daily mean is the average of all valid hourly values for a day. Annex XI of Directive 2008/50/EC stipulates that a daily mean is valid only if at least 18 valid hourly values are available in the 24-hour

period starting 00:00 hours. If the minimum required proportion of valid data is not available, the daily is not calculated for that particular day and a not valid aggregation flag shall be returned.

The daily average shall be calculated for pollutants with environmental objectives based on daily values (SO_2 and PM_{10}) and for which hourly values have been delivered as part of the raw data delivery.

(vi) 8-hour running mean and daily maximum of 8 – hour running mean (daymax)

Legal reference:

Directive 2008/50/EC defines in ANNEX VII and ANNEX XI the following parameters: "*8 hours values and maximum daily 8-hour mean*".

***

Twenty-four values of 8-hour running means and a daily maximum of 8-hour running mean shall be calculated for O_3 and CO.

The 8-hour running mean value for each hour is calculated as the average of the valid hourly values for that hour and the 7 previous hours. Hence, the averaging period of the first 8–hour running mean value of a calendar year of day_n starts with $hour_{18}$ of day_{n-1} and ends with $hour_1$ of day_n (inclusive). Twenty-four hour values of 8-hour running means shall be calculated for each day.

An 8-hour running mean value is valid if at least 6 valid hourly values (i.e. 75% of the values) are available over the 8-hour averaging period. If the minimum required proportion of valid data is not available, the 8-hour running mean is not calculated for that particular hour and a not valid aggregation flag shall be returned.

The daily maximum 8-hour running mean is the maximum of the valid 8-hour running means for that day. Therefore one daily maximum 8–hour running mean shall be obtained for each day. Calculation of all the 8-hour running means (see above) for a given day is a pre-requisite (see example for the calculation of 8-hour running mean).

Annex VII and Annex XI of Directive 2008/50/EC provides that a daily maximum 8-hour mean shall only be calculated if at least 18 valid 8-hour running means (i.e 75% of the hourly running eight hour averages) are available for that particular day.
If the minimum required proportion of valid data is not available, the daily maximum 8-hour running mean is not calculated for that particular day and a not valid aggregation flag should be reported.

Example

Calculation of 8-hour running means of ozone for two different days (3rd and 4th August 1989) is presented below.

Table 21 Calculation of 8 hour running means for ozone

Date/time	hourly mean [observation]	Observation Validity Flag		8 hourly mean [aggregation]	Aggregated Validity Flag
1989-08-02T20:00:00+01	*801*	-1			
1989-08-02T21:00:00+01	*789*	-1			

1989-08-02T22:00:00+01	*801*	-1		
1989-08-02T23:00:00+01	*801*	-1		
1989-08-02T24:00:00+01	*801*	-1		
1989-08-03T01:00:00+01	*802*	-1	*799*	-1
1989-08-03T02:00:00+01		-1	*799*	-1
1989-08-03T03:00:00+01	*799*	-1	*799*	-1
1989-08-03T04:00:00+01	*23*	-1	*688*	-1
1989-08-03T05:00:00+01	*28*	-1	*579*	-1
1989-08-03T06:00:00+01	*204*	-99	*494*	-1
1989-08-03T07:00:00+01	106	1	*106*	-1
1989-08-03T08:00:00+01	107	1	*107*	-1
1989-08-03T09:00:00+01	114	1	*109*	-1
1989-08-03T10:00:00+01	118	1	*111*	-1
1989-08-03T11:00:00+01	123	1	*114*	-1
1989-08-03T12:00:00+01	123	1	115	1
1989-08-03T13:00:00+01	127	1	117	1
1989-08-03T14:00:00+01	132	1	119	1
1989-08-03T15:00:00+01	132	1	122	1
1989-08-03T16:00:00+01	136	1	126	1
1989-08-03T17:00:00+01	136	1	128	1
1989-08-03T18:00:00+01	139	1	131	1
1989-08-03T19:00:00+01	142	1	133	1
1989-08-03T20:00:00+01	143	1	136	1
1989-08-03T21:00:00+01	146	1	138	1
1989-08-03T22:00:00+01	148	1	140	1
1989-08-03T23:00:00+01	154	1	143	1
1989-08-03T24:00:00+01	155	1	145	1
1989-08-04T01:00:00+01	154	1	148	1
1989-08-04T02:00:00+01	155	1	150	1
1989-08-04T03:00:00+01	148	1	150	1
1989-08-04T04:00:00+01	146	1	151	1
1989-08-04T05:00:00+01	142	1	150	1
1989-08-04T06:00:00+01	139	1	149	1
1989-08-04T07:00:00+01	132	1	146	1
1989-08-04T08:00:00+01	127	1	143	1
1989-08-04T09:00:00+01	123	1	139	1
1989-08-04T10:00:00+01	118	1	134	1
1989-08-04T11:00:00+01	136	1	133	1
1989-08-04T12:00:00+01	143	1	133	1
1989-08-04T13:00:00+01	136	1	132	1
1989-08-04T14:00:00+01	106	1	128	1
1989-08-04T15:00:00+01	107	1	125	1
1989-08-04T16:00:00+01	114	1	123	1
1989-08-04T17:00:00+01	123	1	123	1
1989-08-04T18:00:00+01	*201*	-99	124	1
1989-08-04T19:00:00+01	*215*	-99	122	1
1989-08-04T20:00:00+01		-1	*117*	-1
1989-08-04T21:00:00+01	*799*	-1	*113*	-1
1989-08-04T22:00:00+01	*802*	-1	*115*	-1
1989-08-04T23:00:00+01	*801*	-1	*119*	-1
1989-08-04T24:00:00+01	*799*	-1	*123*	-1

where the flags are:

1: Valid

-1: Not valid

-99: Not valid due to station maintenance or calibration

The daily maximum 8–hour running means in the**Error! Reference source not found.** example above are 145 µg/m^3 for 3rd August 1989 and 151 µg/m^3 for 4th August 1989 respectively. The daily maximum 8–hour running mean for 3rd August 1989 is, however, "not valid" since there are less than 18 valid 8–hour running mean values for this day. The daily maximum 8–hour running mean for 4th August 1989 is "valid" because there are more than the required 18 valid 8–hour running mean values for this day.

(vii) Number of hours (or days) with concentration > y µg/m3

Legal reference:

Directive 2008/50/EC, in ANNEX VII and ANNEX XI, defines the parameter as a concentration that, within a given averaging period shall not be exceeded more than a number of times during a calendar year.

***

The *n* - number of hours or days with rounded concentration > y µg/m3 (with y = limit or target value) shall be calculated from the valid measurement values within a calendar year:

Z_1 , Z_2 , Z_3 , … , Z_k , … , Z_{N-1} , Z_N

P is the number of Zk-values for which Zk > y µg/m3 where Zk is the concentration rounded according to the rules given in this guidance in (2) Number of significant digits and rounding. This has to be compared with the number of exceedances in the Directive 2008/50/EC (e.g. 35 days for daily PM10). This is the standard method used for checking compliance with the relevant limit and target values according to the Directive 2008/50/EC.

(viii) Compliance checking

With regard to compliance, a station is in compliance if and only if two conditions are satisfied: (i) it meets the Data Quality Objectives and (ii) the measurement obtained complies with the limit value. One approach would be to regard the first condition as a sine-qua-non for any compliance assessment: that is, stations not meeting the DQOs would simply be discarded for compliance purposes. On that view, for a station to be in definite *non-compliance*, two conditions must also be satisfied: (i) it meets the Data Quality Objectives and (ii) the measurement obtained *does not comply* with the limit value.

But this approach to non-compliance fails to account for some situations. For example consider measurements of the daily limit value for PM_{10}: a station which functions for only three months of the year, in which time it records 36 days of concentrations exceeding 50µg/m^3, does not meet the Data Quality Objectives, but is already clearly in exceedance.

The relevant consideration is that the compliance situation could not possibly have changed had the Data Quality Objectives been met. This is in contrast with a case where, for instance, only 34 days of exceeding concentrations been recorded in the three months of operation. In that case, the situation of 'compliance' (less than 35 exceedances) could certainly have changed had the data capture obligation been met. It is for that reason that satisfaction of the DQOs is essential in order for a station to be in definite compliance.

This circumstance (that a station can be in definite *non-compliance* even when the DQOs are not met) arises only for those limit values that specify a maximum number of exceedances per calendar year. Thus for compliance purposes, specific consideration must be given to these. The following approach should be followed:

-
- every station measurement is checked to assess whether it meets the DQOs; for those measurements that do not, there are then two cases:
    - for the sulphur dioxide hourly and daily limits, the nitrogen dioxide hourly limit and the PM_{10} daily limit, the measurement is checked to assess whether the limit value is exceeded; if so the relevant zone would be in non-compliance;
    - for all other parameters the station measurement is rejected.
- it is assessed whether the number of remaining measurements meets the minimum number of measurements for the zone (as required by the criteria of Annex V and IX of 2008/50/EC and Annex III of 2004/107/EC); if not, the zone would be in non-compliance;
- if the minimum number of measurements is met, it is evaluated whether all measurements comply with the relevant limit value; if not, the zone would be in non-compliance.

For the compliance steps, only the number of exceedances is relevant, and not the percentile (except for PM_{10} in the specific conditions mentioned in Directive 2008/50/EC, Annex I).

Example

Let's assume that a zone of less than 1 million inhabitants has 7 monitoring stations. In this zone, the maximum concentration exceed the upper assessment threshold therefore, according to Annex V of 2008/50/EC the minimum number of monitoring stations for PM_{10} should be 4. PM_{10} is measured in 5 monitoring stations (see Table 22).

Table 22 Compliance checking of one hypothetical zone

Code of station	Type of station	% valid data	Number of exceedances
CCXXXX1	Traffic	95	45
CCXXXX2	Traffic	92	30
CCXXXX3	Urban background	92	38
CCXXXX4	Urban background	90	30
CCXXXX5	Urban background	70	30

It can be seen that station CCXXXX5 does not fulfil the DQO for data capture since the proportion of valid data is smaller than 85% (see also **(iii) Time coverage and data capture**). Nevertheless, the number of monitoring stations in the zone fulfils the minimum requirements i.e. 4. The zone also fulfils the minimum number of background/traffic monitoring station according to the first footnote of Annex V.

One of the environmental objectives for PM10 is the daily limit value for the protection of human health i.e. 50 $\mu g/m^3$ that shall not be exceeded more than 35 times per calendar year. The monitoring stations CXXXX1 and CCXXXX3 are not in compliance with the daily limit value since they exceed in more than 35 days. As a consequence the whole zone is not in compliance with the daily limit value for PM_{10}.

Note:
The example above does not take into account the possibility to reduce the number of monitoring stations according to Article 7 of 2008/50/EC.

(ix) Other relevant statistical values

For statistical exercises, it may be desirable to use measurements which do not meet the DQOs. In situations with time series with a low data capture, the corresponding percentile value will normally give a better indication of the air quality than the number of exceedances (de Leeuw, 2012) where percentile values were shown to be less sensitive to missing data. It is recommended that in these circumstances the percentile is used.

An equivalent approach to using percentiles is a method that is applied in the USA, whereby the number of exceedances during a calendar year is estimated from the number of observed exceedances, using the ratio between the number of valid data and the total number of possible values in a calendar year. More sophisticated versions of this estimation approach can also be applied, for instance by applying the calculation quarterly to account for seasonal variation. An example is provided below. This approach may, in some cases, even provide a better statistical representativeness than the use of percentiles.

A third statistical parameter that can be useful is the Kth highest value, this approach is equivalent approach to the number of exceedances (and thus also highly dependent on data capture).

These methods for deriving these statistical parameters are described below. ***Table 23*** also provides a summary of the relationships between the relevant number of exccedances, percentiles and the kth highest value for the relevant pollutants.

Table 23 Relationship of maximum number of exceedances, percentile and kth highest value

Pollutant	Averaging period for LV/TV	Max number of exceedances	kth highest value	Percentile
SO_2	day	3	4^{th} highest value	99.2 percentile
	hour	24	25^{th} highest value	99.73 percentile
NO_2	hour	18	19^{th} highest value	99.79 percentile
PM_{10}	day	35	36^{th} highest value	90.4 percentile
O_3	day	25	26^{ht} highest value	93.2 percentile

Example

Consider a series of 340 valid daily data for the continuous measurement of PM_{10}. The 306th daily value is 49 µg/m^3 and the 307th daily value corresponding to 90.4 percentile is 51 µg/m^3. The 90.4 percentile is bigger than 50 µg/m^3 but there are only 34 exceedances.

(a) Percentile Calculation

Legal reference:

Directive 2008/50/EC at Annex I.A , Note 1, which states the following: "Member States may apply random measurements [….]. If random measurements are used to assess the requirements of the PM_{10} limit value, the 90,4 percentile (to be lower than or equal to 50 µg/m^3) shall be evaluated instead of the number of exceedances, which is highly influenced by data coverage".

***

Percentiles are primarily used as an additional indicator for the number of exceedances of a given environmental objective and not as relevant parameter used for compliance checking. Percentile are however used for compliance checking where Note 1 of Annex A of Directive 2008/50/EC is applied (see above).

The yth percentile should be selected from the measurement values (valid hourly/daily/day8hmax concentrations) listed in increasing order:

$X_1 \leq X_2 \leq X_3 \leq \ldots \leq X_k \leq \ldots \leq X_{N-1} \leq X_N$

The yth percentile is the concentration Xk, where the value of k is calculated as follows:

$k = q \bullet N$

with q = y/100 and N = number of values. The value of (q • N) should be rounded off to the nearest rank (values < 0.499999… are rounded to 0, values = 0.5 are rounded to 1.

For example, the SO_2 hourly mean should not be exceeded more than 24 hours per year. Thus the 25th highest hourly value must be less than or equal to 350 µg/m^3. In a series of 8760 hourly samples (for one year) ranked in order of increasing size, the k-number of the 25th highest value is 8736. Note that this percentile corresponds with the 25th highest hourly value only if there is a full (i.e.8760) or nearly full dataset. Thus according to the formula, the relevant percentile is:

q = (k /N).100

or in this case, 99.73. The percentile should be specified to the number of decimal places necessary to uniquely identify the relevant k-value. In practice this normally means one decimal place for daily values, and two decimal places for hourly values.

(b) Example of US methodology for uprating exceedances from datasets with low data capture

Legal reference: none

***

For less than complete data sets, an adjustment may be made to the valid measurement data to estimate the number of exceedances for a full calendar year in a way that accounts for the possible effects of losses to data capture. The adjustment is based on the assumption that the fraction of missing values that would have exceeded the limit/threshold level is identical to the fraction of measured values above this level. To account for possible seasonal variations, the adjustment could be applied on a quarterly basis. (Note that if it is applied on an annual basis the outcome is equivalent to use of the percentile approach described above.) The estimate of the expected number of exceedances for the quarter is equal to the observed number of exceedances plus an increment associated with the missing data. The following equation should be used for these computations:

$$e_q = v_q \times \frac{N_q}{n_q} \qquad (1)$$

Where:
eq= the estimated number of exceedances for calendar quarter q;
vq= the observed number of exceedances for calendar quarter q;
Nq= the number of days/hours in calendar quarter q;
nq= the number of days/hours in calendar quarter q with valid daily/hourly values
q = the index for calendar quarter, q = 1, 2, 3 or 4.

The estimated number of exceedances for a calendar quarter should be rounded to the nearest hundredth (fractional values equal to or greater than 0.005 must be rounded up).

The estimated number of exceedances for the year, Ex, is the sum of the estimates for each calendar quarter:

$$Ex = \sum_{q=1}^{4} e_q \qquad (2)$$

The estimated number of exceedances for a year must be rounded to an integer (fractional values equal to or greater than 0.5 are to be rounded up).

(c) kth highest value (maxk)

Legal reference: none

***

Establishing the kth highest value shall be based on ranked valid measurement values

$X_1 \geq X_2 \geq X_3 \geq \ldots \geq X_k \geq \ldots \geq X_{N1} \geq X_N$

The kth highest value is the concentration X_k evaluated in descending order from the maximum (1st highest). The 4th, 25th, 19th, 26th and 36th highest values (kmax) are important for air quality regulations.

Example

The limit value for the protection of human health for PM_{10} is that the daily average of 50 µg/m^3 will not be exceeded on more than 35 days per year. If the 36th highest value is more than 50 µg/m^3, the limit value for PM_{10} has been exceeded.

(x) Further aggregation rules

If hourly values have been delivered for SO_2, PM_{10}, O_3 or CO the following aggregations are calculated before the calculation of the general statistics.

(a) Consecutive hours with concentration > y µg/m^3

Legal reference: Directive 2008/50/EC, in ANNEX XII, defines the parameter "*consecutive hours*".

***

Three consecutive hours are in exceedance when a consecutive measurement triple (Z_{k-1} , Z_k , Z_{k+1}) from a time series of valid measurement values is > y µg/m^3 (with y = alert or threshold value).

Z_1 , Z_2 , Z_3 , … , Z_k , … , Z_{N-1} , Z_N

For every observed triple, the alert requirements of Directive 2008/50/EC must be implemented.

(b) AOT40 (protection vegetation) (only O3)

Legal reference:

Directive 2008/50/EC, Annex VII, provides the following definition: " AOT40 (expressed in (µg/m3) · hours) means the sum of the difference between hourly concentrations greater than 80 µg/m3 (= 40 parts per billion) and 80 µg/m3 over a given period using only the one-hour values measured between 8.00 and 20.00 Central European Time (CET) each day."

***

AOT40 is the cumulative concentration observed above 80 µg/m^3 (= 40 parts per billion) based on hourly measurements. Two statistics shall be calculated as follows;

$$AOT40_{measured} = \Sigma_i \max(0,(C_i - 80))$$

where C_i is the hourly mean ozone concentration in µg/m^3 and the summation is for the period between 08.00 – 20.00 Central European Time each day in a certain time period. There is an exception to this rule for territories which are part of a Member State but over 2000 km away from the closest boundaries of the territory where the capital of that Member State is (e.g. Caribbean islands) for which the statistics should be performed using local time.
For the AOT40 vegetation the time period is the 3 month growing season for crops from 1 May to 31 July each year, whilst for forest protection the time period is from 1 April to 30 September each year.
AOT40 has a dimension of (µg/m^3)·hours and is sensitive to missing values. The required proportion of valid data is 90% of the one hour values over the time period defined for calculating the AOT40 value.
Therefore, $AOT40_{measured}$ shall be routinely corrected to full time coverage to derive $AOT40_{estimate}$ as follows:

$$AOT40_{estimate} = (AOT40_{measured} \cdot N_{period}) / N_{valid}$$

where N_{valid} is the number of valid hourly values and N_{period} is the number of hours in the period.

The following rules apply to calculate five-year-averaged target value for protection of vegetation:

- If the 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 valid data for at least three years.
- The annual AOT40 measured is corrected according to the formula written above.
- A year will participate in the five year average if there is at least 90 % of data coverage between 8 and 20 CET (or local time if the exception applies (see above)) in that year.
- The five years average has to be rounded to the nearest integer.

Note:
Hourly values and the measured AOT40 should not be rounded.

Example

Table 24 Calculation of five – year average for the protection of vegetation

Year	Valid data	% valid data	Valid AOT40 data (max 1104 hours)	% valid AOT40 data	$AOT40_{estimated}$
2008	7841	89,3	1033	93,6	22636
2009	8393	95,8	1068	96,7	6446
2010	8044	91,8	937	84,9	11905
2011	8626	98,5	1094	99,1	15281
2012	8492	96,7	1000	90,6	16768

Note: The 84.9% proportion of valid AOT40 data for 2010 is smaller than the required proportion of valid data i.e. 90%, therefore the $AOT40_{measured}$ or $AOT40_{estimated}$ is not valid.

The proportion of valid AOT40 data in other years being bigger than the minimum requirement, measurements are valid. Therefore the years used to calculate the average is 4 (2008, 2009, 2011 and 2012) which is more than the minimum 3 years.

AOT40 = (22636+6446+15281+16768)/4=15282,75 = 15283

(G) Information on the attainment of environmental objectives (Article 12)

Legal reference:

- Article 27 of Directive 2008/50/EC
- Article 5 of Directive 2004/107/EC
- Article 12 of Decision 2011/850/EU

***

For each zone, pollutant and, environmental objective combination, a declaration of the exceedance or attainment of the relevant environmental objective is to be provided. Where the environmental objective is exceeded, the numerical value of exceedance (as a concentration, percentile or AOT40) or the number of daily or hourly exceedances shall be given for the worst case (highest) exceedance situation observed in the zone.

Where environmental objectives have been exceeded, estimates of the total area, population and road length exposed to levels above the environmental objective shall be reported for each zone as a whole. Associated geometry information (GIS data) shall also be provided. References to the assessment methods observing the exceedances shall also be given e.g. the fixed or indicative measurements, modelling or objective estimation used. Assessment methods are reported within Data flow D.

Where Article 20 or 21 of 2008/50/EC is applicable the following components shall be reported for the worst case exceedance situation in a zone

i. the numerical value of the exceedance or number of exceedances observed considering all contributions;
ii. the numerical value of the exceedance or number of exceedances observed considering WSS contributions i.e. after correcting for WSS contributions;

iii. the numerical value of the exceedance or number of exceedances observed considering NAT contributions i.e. after correcting for NAT contributions;
iv. the final numerical value of the exceedance or number of exceedances observed considering both WSS and NAT contributions i.e. after correcting for both WSS and NAT contributions.

The code list can be found at: http://dd.eionet.europa.eu/vocabulary/aq/adjustmenttype/

In each case for i-iv above estimates of the total area, population and road link exposed to levels above the environmental objective shall be reported for each zone as a whole. Associated geometry information (GIS data) shall also be provided.

(H) Information on air quality plans and (I) Information on source apportionment (Article 13)

Legal reference: Article 13 of 2011/850/EC

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In Dataset G (Information on the attainment of environmental objectives) a dataset report on the overall exceedance situation for a zone, pollutant, environmental objective and protection target combination is provided. This replicates, in general terms, the reporting obligation for the 30 September each year previously implemented in the Air Quality Directives. The exceedances reported in Dataset G for the pollutants covered by 2008/50/EC will (on the first occurrence) trigger an AQ plan. Within AQ plans there is a reporting obligation to provide more detailed regulatory information on air quality management. MS have 2 years to compile this information from the end of the calendar year in which the exceedance was first observed. For the exceedances of the pollutants covered by 2004/107/EC, the areas of exceedance, the source contributing as well as the measures implemented will have to be reported.

An exceedance situation shall be understood as an amalgamation of individual exceedances which by virtue of their similar source apportionment can be managed together.

Where several individual exceedance situations (e.g. different exceedances observed by traffic stations and/or predicted at the roadside by model within the same city) have been grouped into one macro exceedance situation, the source apportionment presented must be relevant to each of the individual exceedance situations and be applicable to the monitoring station or modelled location with the maximum concentration/number of hours exceeding the limit value. If there is a significant difference in source apportionments across the individual exceedance situations, Member States should consider whether it is legitimate to group them into a macro exceedance situation or whether it would be better to split them into smaller groups.

The source apportionment must, in particular, reflect regional, urban and local contributions within the Member State, but also transboundary contributions. As regards the urban and local contributions, a further split must be given in order to identify any significant sources such as transport (road traffic and shipping, where relevant), industry (including heat and power production), agriculture, commercial and residential sources. For PM10, it is also important to indicate significant natural sources.

In the case of NO_2, Member States may choose whether to use nitrogen dioxide or oxides of nitrogen as a basis for source apportionment, as considered appropriate in relation to the exceedance. The choice should be followed consistently and reflected in the quantification of the

impact of individual or groups of measures and allow adequate assessment of the conditions by the Commission.

The 'reference year' refers to the year for which the exceedance has been assessed.

As indicated above, the source apportionment should apply at the monitoring site/modelled location with the highest annual mean concentration/number of exceedances of the hourly/daily limit value. In essence it is asking how much of the exceedance at that single location of maximum exceedance can be accounted for by each of the sources listed. Hence the following equations apply:

- Regional background is the split of total regional background in µg/m³
  The regional background level is the concentration of pollutants on a spatial scale of more than about 50 km. It comprises contributions from outside the exceedance area, but also from sources within the exceedance area. The regional background shall be split, if appropriate data are available, into from within the MS affected and transboundary contributions.

- Urban background increment represents the concentrations arising from emissions within towns or agglomerations, which are not direct local emissions (in µg/m³). It is the sum of the following components: traffic, industry including heat and power production, agriculture, commercial and residential, shipping, non-road mobile machinery, natural, transboundary urban background, and other.

- The local increment identifies contributions from sources in the immediate vicinity of the exceedance situation. The local increment can be estimated as the difference between the concentration measured or modelled at the location of exceedance and the urban background level. It is the sum of the following components: traffic, industry including heat and power production, agriculture, commercial and residential, shipping, non-road mobile machinery, natural, transboundary urban background and other.

- More detailed description of the factors that could contribute to the estimation of the above is given hereafter:
  - Traffic: road traffic emissions only (excludes emissions from non-road mobile machinery);
  - Industry: emissions arising directly from industrial processes and combustion (e.g. sinter plants, BOS furnaces). This excludes emissions from non-road mobile machinery used in industry. Because industry is such a broad category, a page reference to where the relevant information about the relative contribution of different processes can be found in the full air quality plan should be given as a comment (element I.6);
  - Agriculture: emissions arising directly from agricultural activities (e.g. chicken farming). This excludes emissions from non-road mobile machinery used in agriculture;
  - Commercial and residential: emissions from commercial or residential heating (e.g. domestic boilers). This excludes emissions from non-road mobile machinery used in commercial and residential sectors;
  - Shipping: emissions from shipping (excludes emissions from non-road mobile machinery used at ports).
  - Non-road mobile machinery: this includes non-road mobile machinery used in industry, agriculture, commercial and residential sectors and shipping.
  - Natural: sources which are not influenced by human activity, (e.g., dust resuspended from roads, even if having Saharan origin, must be listed under "traffic"; wind-blown dust from crop fields must be listed under "agriculture").

- Transboundary: transboundary (related to national boundaries) contributions to the urban or regional background level

Note:

To calculate an hourly NO_2 source apportionment the following procedure is recommended:

1. Identify which hours were in exceedance of 200 µg m^{-3} (NB this may highlight that the problem is associated with particular time of day e.g. morning rush hour);
2. Use hourly data from the main local source to calculate an hourly contribution from this source. For traffic driven exceedances this is likely to require detailed hourly traffic count data, NO_X emissions estimates and primary NO_2 emissions estimates for different vehicle classes, local meteorological data and a dispersion model. For industrially driven exceedances hourly emissions data from the plant(s) causing the exceedance will be required to estimate hourly emissions and then meteorological data and a dispersion model to estimate concentrations for the relevant hours resulting from the local source.
3. Add on hourly contributions from non-local sources. These are likely to be similar in magnitude to the annual mean contribution from these sources. An alternative method for estimating the contribution from the main local source is to compare the concentrations for the hours with exceedances at the site where the exceedances have been measured with a second site which has similar contributions from urban and regional sources, but little or no contribution from the local source driving the exceedance. For example, the local hourly contribution at a roadside site can be estimated by comparing with a nearby background site. The local contribution at the roadside site can be estimated by subtracting the concentration at the background site.

For pollutants covered by the 4th Daughter Directive, there is no such requirement to report source apportionment upon observing exceedances. As such, the Member States found useful to add the reason codes as from the Decision 461/2004 as a voluntary information. The reason codes should be reported for the worst case exceedance situation.

The code list can be found at: http://dd.eionet.europa.eu/vocabulary/aq/individualexceedances/

Table 25 Reasons for individual exceedances: standard codes

Reason code	Description
S1	Heavily trafficked urban centre
S2	Proximity to a major road
S3	Local industry including power production
S4	Quarrying or mining activities
S5	Domestic heating
S6	Accidental emission from industrial source
S7	Accidental emission from non-industrial source
S8	Natural source(s) or natural event(s)
S9	Winter sanding of roads
S10	Transport of air pollution originating from sources outside the Member State
S11	Local petrol station
S12	Parking facility
S13	Benzene storage

(J) Information on the scenario for the attainment year (Article 13)

Legal reference: Article 13 of 2011/850/EC

***

In dataset J Information on the scenario for the attainment year (Article 13) a dataset report on the baseline scenario and projection scenario for the attainment year is provided.

The baseline prognosis or scenario should represent the 'business as usual' scenario, which includes the effect of existing measures and of measures that have already been decided to reduce pollution, e.g. directives to reduce emissions per vehicle, and also the development in pollution activities, e.g. traffic growth levels.

Typically, a prognosis of the baseline concentration at the location of the exceedance requires model calculations in which the future development of the regional background level, the total background level and the local source contributions are taken into account (see also ***Figure 3***). For the future trend in the regional background, results of model calculations by EMEP (http://www.emep.int) may be used, although expert judgement in their use should be exercised to accurately characterise the local situation. It is not possible to make general recommendations about how best to estimate the developments in the contribution of nearby sources. Model calculations could be done to calculate the contribution of these sources. In these calculations a high level of detail is needed for the contribution from sources that strongly influence the exceedance, e.g. a street model should be used for calculating the concentration at the kerb along a busy road. In this example, the changes in traffic intensities and emission factors need to be taken into account, as their projections for the exceedance area may be quite different to the EU or national averages. It is also important to consider planned or potential new sources in the area.

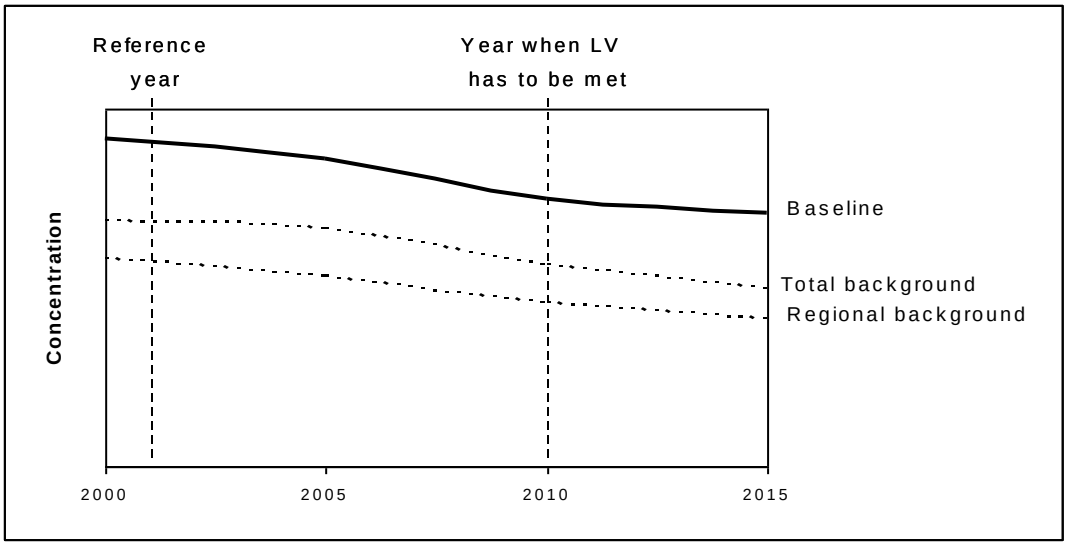

Figure 3 Development of the baseline concentration over time depends on how the regional background level, the total background level and the local contribution develops.

The measures explicitly identified in the AQ plan and introduced in the reported information that are included in this baseline projection should be reported.

In the AQ Plan, the assumptions of the baseline scenario need to be documented, preferably in the form of the changes in emissions of the relevant sources and, as far as appropriate, the effect of existing measures that have not yet come fully into effect. It is always preferable to describe the baseline scenario in terms of emission scenario and to ensure they accurately depict the local situation. If existing calculations, e.g. those by EMEP, are used, it is sufficient to give a reference to the emission prognoses that have been used there. For the development of the local sources, however, no prognosis may be available, and hence the analysis, including the prognosis of emissions, has to be described in the AQ Plan.

The description of the emission scenario is given in free text. In this text, the assumptions regarding the baseline emissions scenario are described. Preferably a reference to background material is given. The total emissions in the relevant area (in kt/yr) means emissions in the area addressed by the AQ Plan, Short – term Action Plan or single measure. Projected emissions should not take into account reduction due to measures that are not in the baseline.

The expected concentration levels in the projection year under baseline scenario shall be expressed as either as annual mean value expressed in µg/m³ (if environmental objective is an average or percentile) or as a number of exceedances (related to the environmental objective specified in the exceedance situation description) per calendar year.

The projection scenario for the attainment year (for each exceedance situation including only fully committed measures) should include measures identified in the AQ-plan that are included in this projection.

A description of the emission scenario used for the projection is given in free text. In this text, the assumptions regarding the emission scenarios are described. Preferably a reference to background material is given. Projected emission should take into account reduction due to measures that are not in the baseline. They shall be reported as the total emissions in the relevant exceedance situation expressed in kt/yr (number). Also, the expected levels in the projection year under projection scenario shall be given as annual mean value in µg/m³ or the number of exceedances (related to the environmental objective specified in the exceedance situation description) per calendar year.

Annex XV of the Air Quality Directive requires a description of the trend of the concentrations prior to the reference year. This information, together with an analysis of the reasons of the observed changes, can be useful for judging the credibility of the calculated future trends. If possible, the trends should be expressed in terms of the parameter of the limit value.

(K) Information on measures (Article 13 and 14)

Legal reference:
- Article 13 of 2011/850/EC
- Article 14 of 2011/850/EC

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In dataset K Information on measures, a dataset report on the measures of the Air Quality Plan or a report on measures required following exceedance of a 2004/107/2004 target value is given. The form and depth of the description of measures in the AQ Plan may depend on the relationship with other existing policy documents on plans and programmes, e.g. a local environmental action plan.

A short description of the measure in terms of action taken and the associated targets has to be given as a free text. Many of the elements described in this section i.e. measure classification, the type of measure, the administrative level responsible for the implementation of the measure; the time scale for its implementation, the sources affected by the measure, the spatial scale of the source affected by the measure as well as the status of the implementation of the measure are part of the respective code lists that are published by EEA at: http://dd.eionet.europa.eu/vocabulary/.

The estimated costs for the implementation of the measure over the whole implementation period should be given, if available. This should take account of the implementation costs including the costs borne by the sector(s) affected as well as the final implementation cost.

In drawing up measures, the responsible authority should consider the secondary effect of their plans on the environment, for example on CO_2 production, and the social effects of the measure. But a report is not required on these secondary effects.

For monitoring the effectiveness of a measure, it is usually not sufficient to just follow how the concentration level changes, as the change may be due to other causes. Hence, it is important to follow the progress of the measures with suitable indicators that relate more directly to the measure. Examples of indicators are:

- have the planned parking fees been implemented [yes/no] and to what extent [number of parking places affected];
- has the planned permit revision been implemented [yes/no];
- how much has the traffic volume on a road gone down [Reduction in numbers of vehicles/vehicle type].

The expected impact upon concentrations in the Projection year i.e. a reduction in concentration level is to be given as a positive number. For annual mean metrics this reduction should be presented in µg/m³ at the monitoring site where the highest levels are recorded. Where there is an exceedance situation without a monitoring site, the point of highest modelled concentrations should be used. Deviation from this rule has to be indicated and explained.

The corresponding code lists can be found at:

http://dd.eionet.europa.eu/vocabulary/aq/measureclassification/
http://dd.eionet.europa.eu/vocabulary/aq/measuretype/
http://dd.eionet.europa.eu/vocabulary/aq/administrativelevel/

http://dd.eionet.europa.eu/vocabulary/aq/spatialscale/
http://dd.eionet.europa.eu/vocabulary/aq/measureimplementationstatus/
http://dd.eionet.europa.eu/vocabulary/aq/statusaqplan/

References:

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Part II

The second part of the guidance describes the details as regards the completion of the “schemata” for the electronic submission of the data flows listed in Annex II of the IPR decision.

The "schemata" contains all the datasets as listed in the IPR Decision i.e.

- (A) Common datatypes
- (B) Dataset "Zones and agglomerations"
- (C) Dataset "Assessment regime"
- (D) Dataset "Information about assessment methods"
- (E) Dataset "Primary data"
- (F) Generated dataset "Aggregated data"
- (G) Dataset "Information on the attainment of environmental objective"
- (H) Dataset "Information on the air quality plan(s)"
- (I) Quantitative source apportionment
- (J) Dataset "Evaluation – Baseline and projection"
- (K) Dataset "Documentation of measures".

Each dataset contains a number of records. Each record contains the following items:

- a reference code,
- an element name and its short description with specification regarding type of data; the specification can be divided in: 1) text where a free text is given, 2) an URL link where e.g the link to the specific document is given, 3) a number or 4) a menu i.e. a code list that is a predefined list of items and their definitions etc.
- a requirement (with a comment); the list of the requirements can be divided in: mandatory (M), conditional (C), generated by the tool (G), generated by external services (X) and voluntary (V).
- cardinality indicates the number of records which are to be reported: singular (represented as 1), multiple mandatory (represented as 1..*), multiple optional (represented as 0..*), singular optional (represented as 0..1).

Example

Reference	Element	Specification	Description	Requirement	Cardinality	Comments 4 requirement
(A) Common datatypes						
A.1	Datatype "Contact Detail"					
A.1.1	Name of the responsible authority, institution or body	Text	The official and complete name of the body (institution, company ...) in charge for a specific reporting obligation	M	1	*In Art.3 of DIR 2008/50/EC are called "competent authorities"*
A.1.2	Web address	URL		C	1	M when available
A.1.3	Name of responsible person	Text		M	1	
A.1.4	Address	Text	Postal address: Unambiguous and complete address including ZIP code	M	1	
A.1.5	Telephone number	Text	Complete numbers including country and area codes.	M	1	
A.1.6	E-mail	Text		M	1	

The next part of the document contains the XML schemata translated into an excel file.

[See separate excel document]