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**EXPLANATORY & GUIDANCE
document (E&G-d)
on IED-based (draft)
Waste Incineration BREF
and BAT conclusions**

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ANNEX 1

**Abbreviations and acronyms
with explanations
+ Toxic Equivalency Factors (TEFs)**

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1. Abbreviations and acronyms (except relating to measurement issues) and explanations

An acronym is an abbreviation pronounced as a word. 'BAT' or 'WID' are usually expressed as acronyms. 'IED' or 'ELV' are usually not.

Abbreviations are presented below in a structured manner in order to facilitate their assimilation. We considered that the alphabetical order was not really necessary to scan the lexicon in an electronic document where the Search function can be used.

1.1 This document

- **E&G-d**: Explanatory and Guidance document (on the WI BREF and its BAT conclusions. It is the present document, made by CEWEP, ESWET and FEAD)

1.2 Documents issued by the EU institutions

- **IPPC directive**: Integrated Pollution Prevention and Control directive (96/61/EC) of 24/09/1996; last revision in 2008).
- **IED**: Industrial Emission Directive (2010/75/EU) of 24/11/2010.
- **Guidance 2012/119**: Commission Implementing Decision 2012/119/EU of 10/2/2012 laying down rules concerning guidance on the collection of data and on the drawing up of BREFs.
- **WID**: Waste Incineration Directive.
The 1st generation of WIDs were, :
 - for non-hazardous waste, directive 89/369/EEC (for new plants) and directive 89/429/EEC (for existing plants) of 21/6/1989 referred together to as WID 1989;
 - for hazardous waste directive 94/67/EC of 16/12/1994, referred to as HWID 1994.The second generation of WIDs was, directive 2000/76/EC of 4/12/2000, called WID 2000, which replaced both WID 1989 and HWID 1994.
WID 2000 was itself merged into (and replaced by) IED (2010/75/EU) of 24/11/2010). It forms Chapter 4 and Annex VI of IED.
- **OJEU**: Official Journal of the European Union
- **CLM BREF**: Production of Cement, Lime, Magnesium oxide BREF.
- **LCP BREF**: Large Combustion Plants BREF.
- **Commission Implementing Decision 2012/249/EU** of 7/5/2012 concerning the determination of start-up and shut-down periods for LCPs
- **WI BREF**: Waste Incineration BREF.
- **WT BREF**: Waste Treatment BREF.
- **ROM**: Reference Report On Monitoring of Emissions to Air and Water from IED Installations.

1.3 Best Available Techniques

- **BAT**: Best Available Techniques.
Warning: in the BAT conclusions chapter of the BREFs (see below), the BAT conclusions are listed as BAT 1, BAT 2 etc. (instead of BAT conclusion 1, BAT conclusion 2, etc.)
- **BREF**: BAT REFERENCE document. BREFs include a chapter called BAT Conclusions – see below).
- **REF**: REFERENCE report. Unlike BREFs, REFs do not include BAT conclusions.

- **BAT Conclusions:** Title of a chapter in all BREFs. (In the WI BREF, it is chapter 5). This wording refers also to the Commission Implementing Decisions into which these chapters are published as stand-alone documents.
- **BAT-c:** a single BAT conclusion included in the BAT conclusions chapter. (NB: This abbreviation has been introduced in this document (E&G-d) to avoid a confusion between BAT (technique) and BAT (conclusion)).
- **BATAELs:** Best Available Techniques Associated Emission Levels. See the definition in IED Article 3.13.
- **BATAEELs:** Best Available Techniques Associated Energy Efficiency Levels.
- **BATAEPLs:** Best Available Techniques Associated Environmental Performance Levels. (BATAEPLs include BATAELs, BATAEELs and other kinds of BAT associated performances, such as the bottom ash unburnt content). The notion of BATAEPL larger than BATAELs appear in Guidance 2012/119.

Wording	Meanings	Comments
BAT conclusions	<ul style="list-style-type: none"> • Chapter of the BREF with the conclusions on BATs 	In the WI BREF, it is Chapter 5
	<ul style="list-style-type: none"> • Commission Implementing Decision with conclusions on BATs 	In principle the content of this Decision is the same as the one of the BREF chapter on BAT conclusions. See the definition of “BAT conclusions” in IED Article 3.11
BAT	<ul style="list-style-type: none"> • General wording for Best Available Techniques 	See the definition of “Best Available Techniques” in IED Article 3.10
	<ul style="list-style-type: none"> • Numbered BAT conclusions in the a.m. chapter of the BREF and in the Commission Decision 	In order not to confuse these BAT conclusions with BATs, they are called ‘BAT-c’ in this E&G-d
	<ul style="list-style-type: none"> • Techniques listed in individual ‘BAT-c’, usually numbered a), b), c), d) etc. 	These are the actual BATs as defined in IED Article 3.10, neither prescriptive nor exhaustive

Table 1.1: Summary of the different meanings of “BAT” and “BAT conclusions”

1.4 BREF drawing up and reviewing process and actors

- **KoM:** Kick-off Meeting of the TWG for the review/drawing up of a BREF.
- **Q:** Questionnaire sent to operators for collection of data to draw up or review a BREF under IED.
- **D1:** First Draft of the (reviewed or new) BREF.
- **FM:** Final Meeting of the TWG for the review/drawing up of a BREF.

- **TWG:** Technical Working Group (set up by the European Commission to draw up and review a BREF. TWGs set for the 1st drawing up of a BREF are reactivated for successive revisions. TWGs include representatives of EC and EIPPCB, MSs, concerned Industry sector and NGOs).
- **EU:** European Union.
- **MSs:** Member States (of EU).
- **EC or COM:** European Commission.
- **JRC:** Joint Research Centre. The JRC is the European Commission's science and knowledge service
- **EIPPCB:** European IPPC Bureau, part of the Joint Research Centre in its Seville office. The EIPPCB is the Technical Office of the European Commission coordinating BREF drawing-up and reviews.
- **Ind.:** Industry.
- **NGO:** Non-Governmental Organisation (involved in Environment).

- **CEWEP:** The Confederation of European Waste-to-Energy Plants (Operators). See CEWEP signature at the **beginning of the Main E&G document**.
- **ESWET:** European Suppliers of Waste to Energy Technology. See ESWET signature at the **beginning of the Main E&G document**.
- **FEAD:** *Fédération Européenne des Activités du Déchet* (European Federation of Waste Management and Environmental Services). See FEAD signature at the **beginning of the Main E&G document**.
- **EHP:** Euro Heat & Power. See EHP signature at the **beginning of the Main E&G document**.
- **JWG:** Joint Working Group. (Specific shadow WG set up by CEWEP, ESWET and FEAD to work on the WI BREF).

- **INERIS:** The French National Institute for Industrial Environment and Risks (*Institut national de l'environnement industriel et des risques*). INERIS is an industrial and commercial public establishment under the aegis of the French Ministry of the Environment. INERIS experts (not members of the TWG) made a specific study on air emissions monitoring and uncertainty in the frame of the WI BREF review. See **Annex 3.b** to this E&G-d.

1.5 Operating conditions

(See **Annex 2** to this E&G-d)

- **NOC:** Normal Operation Conditions. Periods of time when
 - a/ continuously monitored substances must comply with BATAEL-based ELVs
 - b/ periodically (short and long-term sampling) monitored substances must comply with BATAEL-based ELVs as well as with IED Annex VI ELVs.
- **OTNOC:** Other Than Normal Operation Conditions.
- **EOT:** Effective Operating Time.
- **R-EOT:** Relevant EOT, i.e. as soon as and as long as waste is burning. Period of time when continuously monitored substances must comply with IED Annex VI ELVs.
- **NR-EOT:** Non-Relevant EOT. Period of EOT when no waste is burning, i.e. when only the burner(s) is/are in operation.

1.6 Waste types

- **MSW:** Municipal Solid Waste.
- **ONHW:** Other Non-Hazardous Waste.

- **RDF, SRF:** Refuse Derived Fuel, Solid Recovered Fuel. (SRF are RDF complying with certain specifications).
- **C&I Waste:** Commercial and Industrial waste.
- **HW:** Hazardous waste.
- **CW:** Clinical Waste. There are hazardous and non-hazardous clinical waste. The WI BAT conclusions on CW are designed for Infectious or otherwise hazardous CW only. (See section on definitions in WI BAT conclusions)
- **SS:** Sewage sludge.

1.7 Combustion

- **IBA:** Incineration Bottom Ash
- **LOI:** Loss On Ignition. Change in mass as a result of heating a sample under specified conditions. See § on Definitions in WI BAT conclusions.
- **TOC content (in solid residues):** Total organic carbon content. (The quantity of carbon that is converted into carbon dioxide by combustion and which is not liberated as carbon dioxide by acid treatment. See § on Definitions in WI BAT conclusions).
- **TOC (in water):** Total Organic Carbon (expressed as C (in water)); includes all organic compounds. See § on Definitions in WI BAT conclusions).
- **TVOC (in air):** Total volatile organic carbon (expressed as C (in air). See § on Definitions in WI BAT conclusions). NB: this is referred to as TOC in IED Annex VI.)

1.8 Energy

- **CHP:** Combined Heat and Power.
- **TG set:** Turbine Generator set.
- **HE:** Heat Exchanger.

1.9 Emissions

- **ELVs:** Emission Limit Values. Refer to the ELVs set in industrial permits by competent authorities for air and water emissions. There are several sets of ELVs:
 - the current ones based on IED Annex VI requirements (continuous ½-hr, 10-min. and daily within the R-EOT, periodic in NOC)
 - the future ones based on BATAELs in accordance with IED Article 15.3 (continuous daily, periodic and semi-continuous or long-term, all in NOC). **d-ELV:** Daily ELV.
 NB: Article 15.3.b allows to use ELVs higher than BATAELs and to check at least once a year that the emissions do not exceed the BATAEL values.
- **1-2/hr ELV:** Half-hourly ELV.
- **10-min ELV:** 10 minute ELV.
- **FGC:** Flue Gas Cleaning.
- **WWT(P):** Waste Water Treatment (Plant)
- **KEI:** Key Environmental Issue.
- **PCDD, PCDF or PCDD/F:** Polychlorodibenzo-dioxins & furans. Often just called 'dioxins and furans' or even 'dioxins'. (There are 75 dioxins and 135 furans depending on the number of chlorine atoms and of their positions in the molecules. Among these 210 compounds, 17 are classified as toxic). See **Section 3.1 below**.

- **PCB:** Polychlorinated biphenyl ($C_{12}H_{10-x}Cl_x$). Family of 209 compounds.
- **DL-PCB:** Dioxin Like PCB. 12 PCBs are “dioxin-like”. See **Section 3.2 below**.
- **PBDD, PBDF or PBDD/F:** Polybromodibenzo-dioxins & furans. (As for PCDD/F, there are 75 dioxins and 135 furans. Among these 210 compounds, literature considers as toxic the 17 similar to the 17 toxic PCDD/F). See **Section 3.3 below**.
- **PM 10 & PM 2.5:** Particulate Matters with a mean aerodynamic diameter of respectively 10 μm & 2.5 μm . (In practice, refers to particulates with a diameter of respectively 10 μm & 2.5 μm or less).
- **PAH:** Polycyclic aromatic hydrocarbon. (Also polyaromatic hydrocarbon).
- **POP:** Persistent Organic Pollutant as listed in Annex IV to Regulation (EC) No 850/2004 of the European Parliament and of the Council and its amendments. See § on Definitions in WI BAT conclusions).

1.10 Units

- **Nm³:** Normal cubic meter (This notation, given in IED Annex VI Part 3, refers to standardised conditions: 273.15 K, 101.3 kPa. In addition, in IED annex VI ad in the WI BAT conclusions, it also refers to dry gas at 11 % O₂. This is also used in the WI BREF to express air BATAELs).
NB: According to International Standard system Nm³ should mean Newton x m³, which is meaningless. In principle, it should be written as follows: mg/m³_{i.N.dry 11%O₂}
- **µg:** microgram (10⁻⁶ g).
- **ng:** nanogram (10⁻⁹ g). Used for PCDD/F, PCB/DL (and PBDD/F). See **Section 3 below**.
- **TEF:** Toxic Equivalency (sometimes Equivalent) Factor. Apply to individual PCDD/F, DL-PCB (and PBDD/F) congeners. See **Section 3 below**.
- **TEQ:** Toxic Equivalency. Apply to a mixture of PCDD/F, PCB-DL (and PBDD/F). See **Section 3 below**.
- **I-TEQ:** International Toxic Equivalent. See **Section 3 below**.
- **WHO-TEQ:** World Health Organisation Toxic Equivalent. See **Section 3 below**.

2. Abbreviations and acronyms relating to measurement issues with explanations

2.1 Online instruments and Reference methods

- **AMS:** Automated Measuring System (Online measuring system for continuous monitoring of emissions or measurement of peripheral parameters; see EN 14181 standard). Sometimes called CEMS).
According to EN 15267-3:2007, Section 3.1, “AMS: entirety of all measuring instruments and additional devices for obtaining a result of measurement”
And according to EN 14181:2014 standard, section 3:
an AMS is a “measuring system permanently installed on site for continuous monitoring of emissions or measurement of peripheral parameters.”
- Note 1 to entry: An AMS is a method which is traceable to a reference method.”
- Note 2 to entry: Apart from the analyser, an AMS includes facilities for taking samples (e.g. sample probe, sample gas lines, flow meters, regulators, delivery pumps) and for sample conditioning (e.g. dust filter, water vapour removal devices, converters, diluters). This definition also includes testing and adjusting devices that are required for regular functional checks.”
The testing and adjusting devices mentioned above are the ones possibly installed within the AMS for automatic calibration for instance. This does not cover the DAHS¹, nor the SRM for calibration (QAL2, QAL3, AST).
- **Different kinds of AMS:** According to EN 14181:2014 standard, section 3:
 - “**Extractive AMS:** AMS having the detection unit physically separated from the gas stream by means of a sampling system”.
 - “**In-situ AMS:** AMS having the detection unit in the gas stream or in a part of it.”
 - “**Peripheral AMS:** “AMS used to gather the data required to convert the AMS measured value to standard conditions.
Note to entry: A peripheral AMS is used to measure e.g. water vapour, temperature, pressure and oxygen.”
- **CEM or CEMS,** Continuous Emission Monitoring system. (Synonym of AMS. According to EN 15267-3:2007, Section 3.1, “the term AMS is typically used in Europe. The term ‘continuous emission monitoring system’ (CEM) is also typically used in the UK and USA.”).
- **RM:** Reference Method. (“measurement method taken as a reference by convention, which gives the accepted reference value of the measurand.” . See EN 14181 :2014 standard, which refers to EN 15259:2007)
- **SRM;** Standard Reference Method: “Reference method prescribed by European or national legislation.” (See as well EN 14181 :2014 standard referring to EN 15259:2007)
Note: “Standard reference methods are used e.g. to calibrate and validate AMS and for periodic measurements to check compliance with limit values”. SRMs are applied by the control bodies (laboratories) used for the calibration of the AMS).
- **FTIR:** Fourier Transform InfraRed spectrometer. (Technique used to measure the substances continuously monitored from incineration plants except dust (i.e. HCl, HF, SO₂, NO_x, CO and TOC) by obtaining an infrared spectrum of absorption or emission of a solid, liquid or gas).

¹ See quote of EN 14181:2014 on DAHS uncertainty in a footnote in Section 1.3 of Annex 3.a to this E&G.

2.2 Limit of Detection and Limit of Quantification (LOD & LOQ)

- **LoD:** Limit of Detection.
 - Definition in the EIPPCB questionnaire to operators (Main questionnaire, sheet 'Endnote'): "The output signal or concentration value above which it can be affirmed, with a stated level of confidence that a sample is different from a blank sample containing no determinant of interest."
 - More details from Wikipedia: The detection limit is the lowest quantity of a substance that can be distinguished from the absence of that substance (a blank value) with a stated confidence level (for instance 99%).The detection limit is estimated from the mean of the blank, the standard deviation of the blank and some confidence factor. Another consideration that affects the detection limit is the accuracy of the model used to predict concentration from the raw analytical signal. There are a number of different "detection limits" that are commonly used. These include the **instrument detection limit (IDL)**, the **method detection limit (MDL)**, Even when the same terminology is used, there can be differences in the LOD according to nuances of what definition is used and what type of noise contributes to the measurement and calibration.
- **LoQ:** Limit of Quantification.
 - Definition in the EIPPCB questionnaire to operators (Main questionnaire, sheet 'Endnote'): "A stated multiple of the limit of detection at a concentration of the determinant that can reasonably be determined with an acceptable level of accuracy and precision. The limit of quantification can be calculated using an appropriate standard or sample, and may be obtained from the lowest calibration point on the calibration curve, excluding the blank"
 - According to INERIS study N° DRC-17-168319-02463B, Section 2.2, "Various Limit of Quantification (LoQ) method definitions exist. They are not all exactly identical, but mainly LoQ corresponds to the smallest value of a measurand that can be quantitatively determined in defined measurement conditions, with a defined uncertainty."
 - From Wikipedia: The LOQ is the limit at which the difference between two distinct values can be reasonably discerned. The LOQ may be drastically different between laboratories so another detection limit is commonly used that is referred to as the **Practical Quantification Limit (PQL)**.

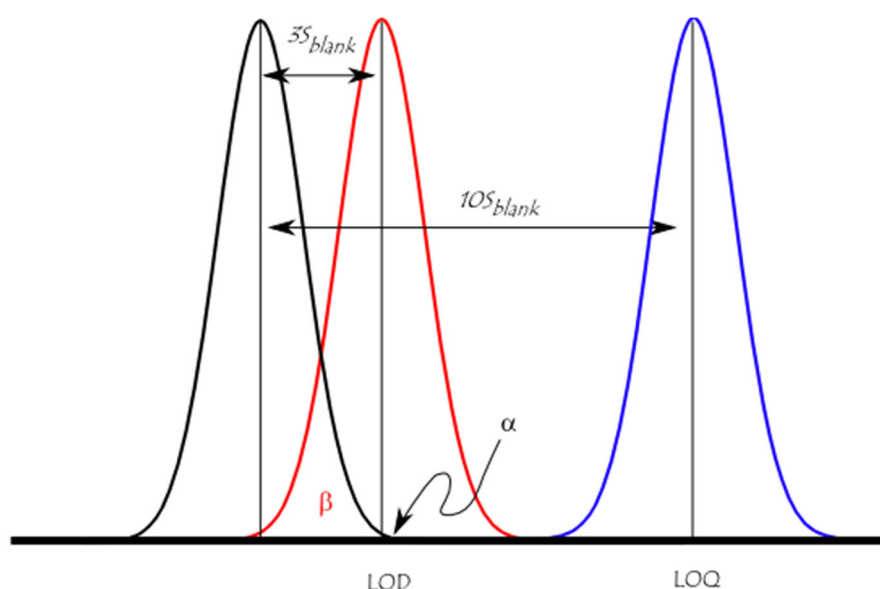


Figure 1.1 — Illustration of the concept of detection limit and quantitation limit by showing the theoretical normal distributions associated with blank, detection limit, and quantification limit level samples. Factors 3S and 10S for example. (From Wikipedia)

Refer also to (p. 38 of) https://www.eflm.eu/files/efcc/Zagreb-Theodorsson_2.pdf

2.3 Confidence intervals and Quality Assurance Levels

- **CI95%:** Confidence Interval at 95%.

According to EN 14181:2014, the confidence interval is the interval estimator (T1, T2) for the parameter θ with the statistics T1 and T2 as interval limits and for which it holds that $P[T1 < \theta < T2] \geq (1 - \alpha)$. See **Figure 1.2** below.

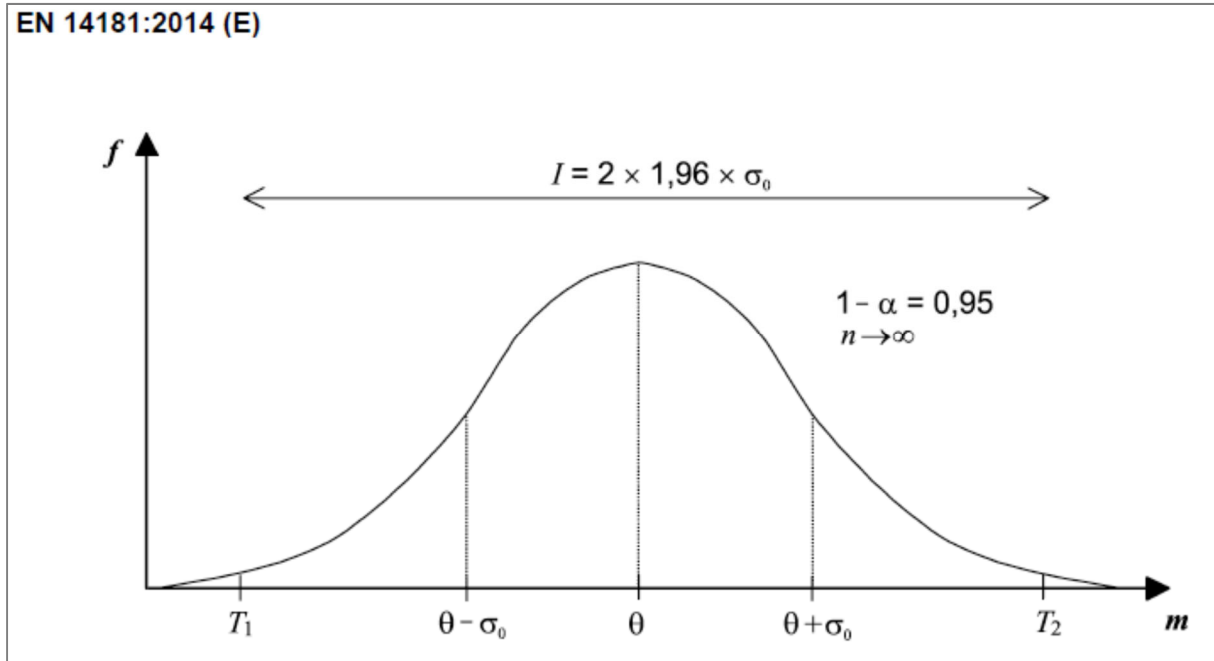


Figure 1.2 — Illustration of the 95 % confidence interval of a normal distribution. Figure from Standard EN 14181:2014 with the following explanation:

Note 1 to entry: The two-sided 95 % confidence interval of a normal distribution is illustrated in Figure 1, where:

$T_1 = \theta - 1,96 \sigma_0$ is the lower 95 % confidence limit;

$T_2 = \theta + 1,96 \sigma_0$ is the upper 95 % confidence limit;

$I = T_2 - T_1 = 2 \times 1,96 \times \sigma_0$ is the length of the 95 % confidence interval;

$\sigma_0 = I / (2 \times 1,96)$ is the standard deviation associated with a 95 % confidence interval;

n is the number of observed values;

f is the frequency;

m is the measured value.

“In this European Standard, the standard deviation σ_0 is estimated in QAL2 by parallel measurements with the SRM. It is assumed that the requirement for σ_0 , presented in terms of a maximum permissible uncertainty, is provided by the regulators (e.g. in some EU Directives). In the procedures of this standard, the premise is that the maximum permissible uncertainty is given as σ_0 itself, or as a quarter of the length of the full 95 % confidence interval.”

- **QAL1:** Quality Assurance Level 1.

Described in standard EN 14181. Details in EN 15267-3 and EN 14956. Used for initial certification of an AMS before being or when put on the market in order to check its suitability for the measuring task. The procedure consists in verifying that the total uncertainty of the AMS, calculated by appropriately summing up all the relevant uncertainty components arising from the individual performance characteristics, does not exceed 75% of the uncertainty required by the

applicable legislation². QAL1 procedure includes at least 3 months field approval of two AMSs (CEMSs) consisting of probe, filter and heated sampling line, etc.

- **QAL2:** Quality Assurance Level 2.
Specified in EN 14181, which indicates in its introduction that it is “to assure that AMS installed to measure emissions to air are capable of meeting the uncertainty requirements on measured values given by legislation, e.g. EU Directives [1], [2], [3] (i.e. WID 2000, LCP 2001, IED 2010) or national legislation, or more generally by competent authorities”. Onsite calibration with SRMs of online instruments (AMSs) performed by third party control bodies (laboratories) to determine the calibration function and validate this function.
QAL2 should be done every 3rd year for incineration plants after first installation and subsequently all three years (and every 5th year for other plants). To be done also after each major changes of the AMS (new cell, optical filter, additional components, etc. and/or refurbishment and changes of abatement system of the plant)
QAL2 is a procedure for the determination of the AMS calibration function as well as a test of the variability of the AMS-measured values compared with the maximum permissible uncertainty given by legislation³.
- **QAL3:** Quality Assurance Level 3. (Specified in EN 14181. Used to check drift and precision in order to demonstrate that the AMS is in control during its ongoing operation so that it continues to function within the required specifications for uncertainty.
- **AST:** Annual Surveillance Test. (Specified in EN 14956 and EN 14181. Intermediary test between two QAL2 tests in order to evaluate (i) that the AMS functions correctly and its performance remains valid and (ii) that its calibration function and variability remain as previously determined.

2.4 Uncertainty assessment

- **GUM:** Guide to the expression of Uncertainty in Measurement. See ISO/IEC Guide 98-3: Uncertainty of measurement — Part 3 (GUM: 1995).
- **ILC:** Inter-Laboratory Comparison.
An ILC consists in testing the same samples by different laboratories and in comparing the results.
Accredited laboratories participating to ILC tests should preferentially use standardised methods of analysis. They are required to participate to ILC tests for demonstrating their technical competence to their customers and to ensure comparability and acceptability of the testing results produced by them.

2.5 Data Acquisition and Handling System

- **DAHS:** Data Acquisition and Handling System.

The following definitions come from the new standard on DAHS (EN 17255-1). See **Annex 3.d** to this E&G-d.

² According to EN 14181:2014, § 3.15, note 2 : In some EU Directives the uncertainty of the AMS measured values is expressed as half of the length of a 95 % confidence interval as a percentage P of the emission limit value E. Then, in order to convert this uncertainty to a standard deviation, the appropriate conversion factor is: $\sigma_0 = P E / 1.96$.

It is the case of the Industrial Emission Directive which, in its Annex VI, Part 6, para. 1.3, provides, for the incineration relevant Automated Measuring Systems, the maximum values of the 95 % confidence intervals at the daily emission limit value level.

³ Same as previous note.

- **Valid data:** data which are deemed to have passed particular quality requirements related to a specified usage.
- **Data product:** defined data, recorded or calculated from input data, with a specified method of determination, and available to the user of the DAHS as a recognised data set.
- **Plant process parameter:** specified quantity describing plant conditions or other plant information.
- **FLD, First Level Data:** raw data or average values calculated from the raw data, both including status signals.
- **Status signal:** binary value or enumerated value from the plant, AMS or operation personnel signifying a specific state of operation.
- **LTA, Long-Term Average:** average calculated from SSTA or VSTA over a specified time period. For waste incineration, it is the daily average.
- **STA, Short-Term Average:** average related to the shortest time period used for reporting
 - Note 1 to entry: Short-term averages are based on the shortest time period of averages the plant shall report to the authorities for each measured component. According to variations in different EU Directives the shortest time period can be 10 min, 30 min or 1 h, depending on the type and application of the plant. For waste incineration plants, it is half hour (or possibly for CO10 minutes).
- **SSTA, Standardised Short-Term Average:** short-term average converted to standard conditions using short-term averages of peripheral parameters
- **VSTA, Validated Short-Term Average,** standardized short-term average with the relevant confidence interval subtracted to comply with EU Directive reporting requirements
- **Reportable mode:** mode or modes of plant operation during which reporting is required for a specific regulatory requirement.
 - Note 1 to entry: Reportable modes can include start-up, shut-down and normal operation.
 - Note 2 to entry: Different reporting requirements define different reportable modes. The term 'reportable mode' is therefore used in this document [the draft standard] to refer collectively to whichever specific conditions are applicable for a given reporting regulation.

3. Toxic Equivalency Factors (TEFs)

Toxic equivalency factors (TEFs) express the toxicity of toxic dioxins, furans and PCBs in terms of the most toxic form of dioxin, 2,3,7,8-TCDD. The toxicity of the individual congeners may vary by orders of magnitude.

With the TEFs, the toxicity of a mixture of dioxins and dioxin-like compounds can be expressed in a single number - the toxic equivalency (TEQ). It is a single figure resulting from the product of the concentration and individual TEF values of each congener.

3.1 TEFs for PCDD/F

WI BAT-c n°30 requires to use the I-TEQ⁴ Toxic Equivalency Factors (TEF) for PCDD/F. Emissions are expressed in ng I-TEQ/Nm³.

The table **below** shows the TEFs as given in IED Annex VI Part 2.

PCDD/F		I-TEQ TEF (IED Annex VI Part 2)
PCDD	2,3,7,8 — Tetrachlorodibenzodioxin (TCDD)	1
	1,2,3,7,8 — Pentachlorodibenzodioxin (PeCDD)	0,5
	1,2,3,4,7,8 — Hexachlorodibenzodioxin (HxCDD)	0,1
	1,2,3,6,7,8 — Hexachlorodibenzodioxin (HxCDD)	0,1
	1,2,3,7,8,9 — Hexachlorodibenzodioxin (HxCDD)	0,1
	1,2,3,4,6,7,8 — Heptachlorodibenzodioxin (HpCDD)	0,01
	Octachlorodibenzodioxin (OCDD)	0,001
PCDF	2,3,7,8 — Tetrachlorodibenzofuran (TCDF)	0,1
	2,3,4,7,8 — Pentachlorodibenzofuran (PeCDF)	0,5
	1,2,3,7,8 — Pentachlorodibenzofuran (PeCDF)	0,05
	1,2,3,4,7,8 — Hexachlorodibenzofuran (HxCDF)	0,1
	1,2,3,6,7,8 — Hexachlorodibenzofuran (HxCDF)	0,1
	1,2,3,7,8,9 — Hexachlorodibenzofuran (HxCDF)	0,1
	2,3,4,6,7,8 — Hexachlorodibenzofuran (HxCDF)	0,1
	1,2,3,4,6,7,8 — Heptachlorodibenzofuran (HpCDF)	0,01
	1,2,3,4,7,8,9 — Heptachlorodibenzofuran (HpCDF)	0,01
	Octachlorodibenzofuran (OCDF)	0,001

Table 1.2: I-TEQ TEF for PCDD/F as given in IED Annex VI, Part 2

⁴ I-TEQ, International toxic equivalent factors according to the North Atlantic Treaty Organization (NATO) schemes.

3.2 TEFs for PCB-DL

WI BAT-c n°30 requires to use the WHO-TEQ⁵ Toxic Equivalency Factors (TEF) for PCB-DL because there are no toxic equivalent factors for PCB-DL in the I-TEQ scheme. Emissions are expressed in ng_{WHO-TEQ}/Nm³.

The table below shows the TEFs in WHO-TEQ for PCB-DL.

PCB-DL		WHO-TEQ 2005
Non-ortho-substituted PCBs (coplanar)	3,3',4,4'-TCB (77)	0,0001
	3,3',4',5-TCB (81)	0,0003
	3,3',4,4',5-PeCB (126)	0,1
	3,3',4,4',5,5'-HxCB (169)	0,03
Mono-ortho- substituted PCBs	2,3,3',4,4'-PeCB (105)	0,00003
	2,3,4,4',5-PeCB (114)	0,00003
	2,3',4,4',5-PeCB (118)	0,00003
	2',3,4,4',5-PeCB (123)	0,00003
	2,3,3',4,4',5-HxCB (156)	0,00003
	2,3,3',4,4',5'-HxCB (157)	0,00003
	2,3',4,4',5,5'-HxCB (167)	0,00003
	2,3,3',4,4',5,5'-HpCB (189)	0,00003

Table 1.3: WHO-TEQ TEF for PCB-DL

⁵ WHO-TEQ, Toxic equivalent factors according to the World Health Organization (WHO) scheme.

3.3 TEFs for PBDD/F

Up to now (November 2019), TEFs have not been defined for PBDD/F. Literature⁶ suggests to use similar Toxic Equivalent Factors (TEF) for both brominated and chlorinated congeners. The table below shows the TEFs for PBDD/F according to those of corresponding PCDD/F.

PBDD/F		Same TEF as I-TEQ TEF for PCDD/F (IED Annex VI Part 2)
PBDD	2,3,7,8 — Tetrabromodibenzodioxin (TBDD)	1
	1,2,3,7,8 — Pentabromodibenzodioxin (PeBDD)	0,5
	1,2,3,4,7,8 — Hexabromodibenzodioxin (HxBDD)	0,1
	1,2,3,6,7,8 — Hexabromodibenzodioxin (HxBDD)	0,1
	1,2,3,7,8,9 — Hexabromodibenzodioxin (HxBDD)	0,1
	1,2,3,4,6,7,8 — Heptabromodibenzodioxin (HpBDD)	0,01
	Octabromodibenzodioxin (OBDD)	0,001
PBDF	2,3,7,8 — Tetrabromodibenzofuran (TBDF)	0,1
	2,3,4,7,8 — Pentabromodibenzofuran (PeBDF)	0,5
	1,2,3,7,8 — Pentabromodibenzofuran (PeBDF)	0,05
	1,2,3,4,7,8 — Hexabromodibenzofuran (HxBDF)	0,1
	1,2,3,6,7,8 — Hexabromodibenzofuran (HxBDF)	0,1
	1,2,3,7,8,9 — Hexabromodibenzofuran (HxBDF)	0,1
	2,3,4,6,7,8 — Hexabromodibenzofuran (HxBDF)	0,1
	1,2,3,4,6,7,8 — Heptabromodibenzofuran (HpBDF)	0,01
	1,2,3,4,7,8,9 — Heptabromodibenzofuran (HpBDF)	0,01
	Octabromodibenzofuran (OBDF)	0,001

Table 1.4: I-TEQ TEF for PBDD/F corresponding to PCDD/F I-TEQ TEF as given in IED Annex VI, Part 2

⁶ For instance, see p. 30 of Filip Bjurlid (2018): Polybrominated dibenzo-p-dioxins and furans <https://www.diva-portal.org/smash/get/diva2:1155143/FULLTEXT01.pdf>