CODE OF GOOD PRACTICE FOR APPROVAL OF LONG TERM DIOXIN SAMPLING EQUIPMENT IN STACKS

Raf De Fré, Mai Wevers

Code elaborated by the Working Group
"Approval of long term dioxin sampling equipment in stacks"

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1 INTRODUCTION

This code of good practice was elaborated in 2002 by the Working Group **"Approval of long term dioxin sampling equipment in stacks"** chaired by VITO. The subject is the method to be used by certified experts for the initial approval of long term dioxin sampling instruments, as prescribed by the environmental legislation.
This document was written after 3 meetings of the Working Group, and was based on technical data of systems existing at that time, on work visits at two municipal waste incinerators where different types of sampling systems were in operation, and on comments and experiences of working Group participants.

Note about this version: VITO is the reference laboratory for environmental measurements in Flanders. This English translation of the earlier version of the code is part of the reference laboratory's program for revision of the code in 2008 and 2009. The text is the same as the 2002 Dutch version with a few minor textual corrections and clarifications.

1.1 Objective of long term sampling of PCDDs and PCDFs

The continuous sampling of dioxins is required according to Vlarem article 5.2.3.3 to ensure a permanent surveillance of the total dioxin emission of a plant, including phases such as start up, shutdown, and disturbances of normal operation, when e.g. by incomplete combustion an increased risk of elevated dioxin emissions may exist.

Compared to the emission limit value of 0,1 ng TEQ/Nm³ which needs to be complied with for periodical measurements with a sampling duration of 6 to 8 hours, according to the EN 1948 standard, it can be assumed that a guide value of 0,1 ng TEQ/Nm³ applicable for the whole period of operation, including the episodes of abnormal operation of the process, is a more severe condition, which is more difficult to satisfy.

The objective of long term sampling is to guarantee a practically faultless operation of combustion plants as for dioxin emissions, especially the close watch of all available measures to prevent dioxin formation and to reduce emissions. Plant operators are expected to take additional measures to control emissions in upset conditions, e.g. by timely deployment of support burners, or shutdown of the combustion.
Prior to approval the certified expert has to investigate and confirm that the system delivers representative samples for the total emission of the plant.

1.2 Acceptable principles of sampling

The actually commercially available systems for continuous sampling of dioxins use an automated isokinetic sampler with a cooled probe which is similar to the cooled probe method described in EN1948-1. In this system the flue gases are cooled drastically below their water dew point in the probe before they pass the filter. Flue gases, condensate and particulate matter are drawn over a cartridge filled with a glass wool plug and an adsorbent polymer resin (XAD-2). Particles are supposed to remain on the glass wool plug and PCDDs and PCDFs are supposed to be adsorbed on the XAD-2 while the condensate percolates through the XAD-2 cartridge. Only the XAD-2 cartridge with the glass wool plug is transferred to the laboratory as one sample to be analysed according to EN 1948 parts 1 & 2.

The other manual sampling methods as described by EN 1948-1, filter-condenser and dilution methods, if they are adapted for long term sampling, are by principle not excluded for the legally required continuous sampling, but at the moment no such systems are in use in Flanders.

This code does not implicate a preference for one or another system and the requirements are defined as general as possible. Nevertheless there are references to specific parts of the now existing equipment, and it was impossible to take into account technical peculiarities of systems that are not yet applied.
Alternative measurement methods like a continuous dioxin monitoring, if this would be possible according to the state of the technology, could be considered, on the condition that the averages can be generated over the legally required 2-week period (Vlarem II Art.5.2.3.3.6.§1.1°d): "additionally to c) starting from January 1, 2000 the polychlorinated dibenzodioxins and polychlorinated dibenzofurans have to sampled in a continuous way, with at least two-weekly analyses**;** for the thus obtained results a guide value of 0,1 ng TEQ/m³ is applicable).
Continuous instrumental measurement of indicator parameters or sampling of indicator compounds (like PCBs or chlorobenzenes) is not explicitly allowed in the legislation, and can only be accepted if it is stipulated in the environmental permit as an equivalent method according to Vlarem II article 4.4.4.2 (equivalent method with the same accuracy).

1.3 The recognized environment expert

The expert has to dispose of the technical means and knowledge to inspect the quality control of the measurement system. As a proof thereof experts are officially recognized by the Flemish Government.
The recognized expert shall, as stipulated in Vlarem article 1.3.3.1. apply the quality standard NBN EN 45001 and have a quality manual. The standard EN 45001 is to be replaced in due term by ISO 17025 .

The expert shall have no ties with the seller, the owner or the user of the dioxin sampling equipment. The report by the expert shall be limited to observations by the expert himself and shall mention every observed nonconformity or shortcoming. The experts report shall only give clarification of the causes of observed shortcomings if these were concluded by the expert himself. If it is necessary for the corrective actions to add clarifications from the user or the operator, then these sources have to be cited explicitly.
The result of the approval must not affect the remuneration and must be obtained free of external pressure. The holder of the environmental permit is the commissioner of the approval and bears the cost.

"Testing and approval of instruments for continuous dioxin sampling" will be included as a specific task for which recognition can be obtained, as an option under package 17 "Approval of continuous emission measurement equipment" (to be specified) of annex 1.3.2.2 of Vlarem II. Until then only labs that are certified for the actual package 17 are qualified for this task.

2 LEGAL REQUIREMENTS IN VLAREM

2.1 Sectors

Note: Vlarem is the Flemish legislation about environmental permits. The following is a summary of the legislation at the time this code was published first.
According to article 5.2.3.3.6.§1.1°c) Vlarem for municipal waste incineration it is required to measure once a year the emission of chlorinated dioxins and furans following NBN-EN 1948. "Additionally and starting from January 1, 2000 polychlorodibenzodioxins and polychlorodibenzofurans shall be sampled in a continuous way with analysis at least every 2 weeks; for the results obtained in this way a guide value of 0,1 ng TEQ/Nm³ shall apply". This requirement does not concern combustion plants where non dangerous treated waste wood is burned nor combustion plants where untreated waste wood is burned with a capacity of more than 1 ton/h untreated waste wood. For combustion installations where non dangerous treated wood is burned however, in addition to the yearly measurement as stated in art. 5.2.3.3.6,§1,1°, c of Vlarem title II, at least one second measurement of chlorinated dioxins and furans in the same calendar year is required on the initiative and at the expense of the plant operator. For this second measurement also the emission limit value of 0,1 ng TEQ/Nm³ applies.
The period between the yearly measurement as stated in Vlarem II Art. 5.2.3.3.6, § 1, 1°, c and the second measurement shall be at least one month and at most six months.

For the other sector with measurement requirement for dioxins, the following rules apply:

Combustion plants for dangerous waste (5.2.3.2) have a dioxin emission measurement frequency of 2 times a year.

Petroleum refineries (5.20.2), Metals processing plants (5.29), Combustion installations for wood of the first class, limited to new and existing large and medium size plants (5.43) and Crematoria (5. 58) have to measure dioxin emissions according to EN 1948 at least once a year. However if the measured concentration, after taking into account the accuracy, exceeds the emission limit value, within 3 months a new sampling and analysis shall be performed.

In practice since January 2000 only in the sector of household waste combustion long term dioxin sampling is applied.

2.2 Relevant general regulations

From the general clauses in the Vlarem II legislation concerning measurements of emissions into the air the following requirements can be formulated:
- the results are expressed in standard reference conditions (0° C, 1013 mbar, dry gases, reference oxygen concentration)
- the method follows a code of good practice
- the total measurement uncertainty is 30% at maximum
- the range of measurement is between 0,1 and 3 times the emission limit value.

As the results of long term dioxin sampling are compared to a guide value and not to an emission limit value, strictly some of the Vlarem stipulations do not apply literally.

Reasonably however it will only be necessary to deviate from these stipulations if the specificity of the method would require so.

From the objectives of permanent dioxin sampling, the general requirements to be imposed on the systems applied can be derived:
- continuous sampling in time, also during period of "abnormal" operation of the plant
- representativity for the total emission flux
- comparability to the reference method, as far as possible.

3 INQUIRY OF INSTALLATION PROPERTIES

3.1 Instrument suitability

As for automated emission measurement systems a test certificate from an accredited test institute such as TüV offers a number of advantages in the assessment of the suitability of an instrument.
If critical parameters of the instrument were already certified this diminishes the burden of proof for the plant owner and the expert. Nevertheless an approval by TüV or a similar accredited institute is not an absolute requirement to fulfil the legal Vlarem requirements.

If the instrument does not possess a type approval certificate the following properties and performance characteristics need to be verified and reported by the expert:
- comparability of results with a standard sampling method
- suitability of absorber cartridge dimension to prevent breakthrough
- inertness of used materials
- efficiency of the cooling of the sampled gas for the cooled probe and filter condenser methods, heating of the probe for the filter-condenser method and for the dilution method, the determination of the dilution factor
- period of unattended operation and maintenance requirements
- treatment of abnormal situations (status signals) and continuity of sampling
- registration and reporting of data
- control of isokinetic sampling rate
- determination of sampled volume.

These verifications imply that the expert makes an inquiry into these properties and that he shall base his eventual approval on traceable data about his findings (test results, measurements, transferable documentary data).

3.2 Position in the flue gas duct

The sampling of dioxins has to be representative of the whole emission flow, and has to include the particulate phase, the gas phase and eventually present droplets. The sampling position in the duct therefore has to comply with a standard method for the sampling of dust. This means that no obstacles, bends, addition of air or other disturbance shall be present at a distance of a prescribed number of hydraulic diameters from the sampling point.
This selection of the sampling position is a minimum requirement but does not guarantee the homogeneity of the gas flow. For this reason it is indicated to apply the distance requirements with ample margin.

If for practical reasons it cannot be avoided to deviate from the prescriptions for the sampling plane, then the representativity of the sampling location shall be demonstrated. This can be achieved by a certified laboratory by means of grid measurements (see e.g. § 3.3 and Code of good practice "Approval of fixed emission measurement instruments").
The sampling of dioxins requires representativity over a period of 14 days.

The sample line from the probe to the sampling unit shall be as short as possible, to avoid deposition of dust and adsorption of PCDDs and PCDFs in the tubing and couplings.
During the installation of the dioxin sampling equipment attention has to be given that the openings for all required independent measurements remain available.

3.3 Representativity of the sampling section

Considering that the actual instruments take a sample from a single point, it is indicated to further demonstrate the representatitvity of this point in case it does not comply with the conditions of the paragraph above. This can be done by means of measuring other parameters such as oxygen concentration, temperature, velocity, CO_2… A time averaged measured value at the sampling point is compared with the weighted average obtained for the whole section.

If the sampling section fulfils the conditions of the standard NBN T95-001 (velocity measurements) for the measurement plane, then it can be assumed by approximation that the centre point is sufficiently representative.

In the area where the sampling probe is positioned, preferably the flue gas velocity should not show strong variations as a function of time and distance (depth of insertion). In this way a constant suction velocity still can deliver representative samples in case the isokinetic sampling rate cannot be maintained. However it remains an essential requirement that the sampling rate is controlled isokinetically.

Possible criteria for the evaluation of homogeneity can be found in ISO 10396, ISO 9096 and NBN-EN 1911.

According to ISO 10396 “Stationary source emissions – Sampling for the automated determination of gas concentrations” the gas composition over the duct diameter is homogeneous if not more than 15 % variation occurs in the concentrations measured at different points.

According to ISO 9096 “Stationary source emissions – Determination of concentration and mass flow rate of particulate material in gas-carrying ducts – Manual gravimetric method” the measuring location is suitable when:
- the angle between gas flow and duct axis ≤ 15°
- no local negative gas flows occur
- the ratio of highest and lowest velocity ≤ 3:1
- the temperature in K in each individual point deviates at maximum 5% from the average temperature

EN 1911 “Stationary source emissions – Manual method of determination of HCl – Part 1: Sampling of gases” states that a gas flow is homogeneous if:

- the standard deviation of the velocities is less than 10% of the average velocity
- the local temperatures do not differ by more than 10°C from each other
- the standard deviation of the O_2-concentration relative to the average value does not exceed 10%.

4 CHECKS ON THE OPERATION OF THE INSTRUMENT

4.1 Isokinetic sampling

Isokinetic sampling is a requirement for representative sampling of the particulate fraction. Additionally isokinetic sampling has the advantage that a flow weighted average sample is taken.

The deviation from the isokinetic sampling rate has a larger effect when larger particles are present. Water droplets can have very large diameters relative to the dust that is usually present in emissions. In the presence of droplets therefore special attention is required to the accurate control of isokinetism. In general overisokinetic sampling will produce lower errors than subisokinetic sampling.
In the actual waste incineration plants emissions dust concentrations are low and in the case of unsaturated gases no appreciable effect of isokinetic sampling is expected, as the remaining particles have very small diameters. In certain conditions therefore non-isokinetic sampling can be considered. However the condition that the sample shall be proportional to the gas flow must remain fulfilled. Table 1 gives an overview of calculated errors from unrepresentative sampling due to deviation from isokinetic sampling velocity, whereby C_O is the actual dust concentration, and C_i the collected apparent concentration, U the flue gas velocity and v the velocity of sampling.

Table 1: Deviation of measured from real dust concentration by anisokinetic sampling (air 20 °C, nozzle diameter 10 mm, gas velocity U = 10 m/s)

Aerodynamic diameter dust	Over-isokinetic	Under- isokinetic
µm	U/v = 0,5	U/v = 2
	A=Ci/Co	A=Ci/Co
0,01	1,000	1,000
0,05	1,000	1,000
0,1	1,000	1,000
0,5	1,000	1,000
1	1,000	1,001
2	0,998	1,003
3	0,996	1,006
5	0,988	1,018
10	0,955	1,067
20	0,857	1,222
50	0,643	1,640
100	0,546	1,877

From table 1 it is clear that for particles smaller than 5 µm a deviation by a factor of 2 from isokinetic sampling velocity has no relevant effect on the result.
Furthermore it can be calculated that the effect of deviations from isokinetic sampling are increasingly important with increasing flue gas velocity and decreasing nozzle diameter.
For particles larger than 50 µm (e.g. a fine water spray) the error with 20 % deviation from isokinetism in both directions is of the order of 15 % (nozzle 6 mm, U= 10 m/s).

The expert shall check the calculations of the isokinetic sampling rate during an elementary period of sampling as a proof of the correct operation and adjustment of the equipment.
For a meaningful verification the period over which this calculation is made shall be sufficiently short to avoid large fluctuations of velocity during the time interval considered.

4.2 Sampling duration

Vlarem II requires continuous sampling of dioxins with analysis of samples at least every 14 days. The sampling equipment shall be sufficiently autonomous to sample this whole period without interruption. Combination of samples from several shorter periods is in principle possible, in as far as interruptions due to the change of samples do not cause significant skipped periods of time and in as far the validity of the samples is not at risk (e.g. by increased blanks or detection limits).
If the sampling period is extended over 4 weeks, this requires validation of the sampling system for this purpose.

4.3 Start and stop criteria

The start-up and shutdown of a waste combustion plant are very critical phases for the risk of elevated dioxin emissions. Therefore the long term dioxin sampling equipment shall in no case systematically skip these phases.
However it is not desirable that the instruments continue sampling during standstill of the combustion, because then dilution air is drawn over the sample (although this air in the chimney can still contain dioxins, and although this dilution of the volume is in fact corrected by applying a reference oxygen concentration).

An additional consideration is the presence of support burners. If the temperature during start-up is too low, the oxygen concentration is lowered by the presence of flue gases from oil or natural gas.

Possible criteria to decide that the plant is in operation are:
- a maximum oxygen concentration (18 %) in the flue gases of the combustion plant
- a minimum flue gas velocity through the chimney
- a minimum temperature in the (post) combustion chamber

Other but less indicated criteria, which cannot be applied as a sole trigger for operation of the continuous dioxin sampling, are:
- feeding of waste
- movement of the grates
- decision of an operator to manually switch off the sampling.

4.3.1 Practical operation procedure for approval of start and stop criteria

The expert shall evaluate whether the start and stop criteria are adapted to the legal requirements in Vlarem, the requirements of this Code and the typical characteristics of the installation. Additionally he shall verify that the criteria are functioning properly in practice. For both test two alternative methods of inspection are applicable.

Approval of the start and stop criteria
With the approval of the applied start and stop criteria the expert shall demonstrate that no substantial emissions are possible outside the sampling period.

Method by measurement
The proof that the interruptions applied by the equipment are not causing the exclusion of episodes with significant emissions can be delivered by actual samplings and analyses that cover several interruption periods of the equipment. In practice it will not be possible to obtain comparable sample volumes for the periods of shut down. The test should aim at combining several starts and stops (at least one of each) and to collect a sample volume as stipulated in EN 1948 with a minimum sampling duration of 6 hours. Practically this can be obtained with a manual sampling system according to EN 1948 and the use of large diameter nozzle.
Taking into account the measurement uncertainty on this determination the emission during the stop periods should not amount to more than 20 % of the emission limit value. If this criterion cannot be met the stop criteria have to be adapted.

Demonstration of non-relevance of emissions during shutdown time
Alternatively an argumentation with actual and theoretical elements can be developed and submitted to the authorities for approval.
Actual elements can be: the low frequency or short duration of stop periods; theoretical elements can be e.g. the deriving of the degree of operation of the plant from the oxygen concentration in the flue gas.
In combustion plants with liquid and gaseous fuel 18% oxygen is sometimes applies as a criterion for standstill. This means a flue gas dilution by a factor 6 compared to the reference situation with 3% O_2. In plants with a reference oxygen concentration of 11% the same dilution factor results in 19,3 % O_2 as a criterion for shut down.

Functional test

Actual test
The correct operation of start and stop criteria is tested by generating simulated signals that correspond to the trigger parameters and checking if the equipment reacts in the expected manner.

Method by checking historical recordings
During the approval procedure the expert shall examine some real cases when the sampling was interrupted sampling (i.e. not those stops that were eventually simulated during the test procedure). In this process he will examine the criteria that were set, the recorded values of the criterion parameters and whether the control system reacted properly. As with the previous method all parameters that can trigger start and stop should be subject to scrutiny.

4.4 Interrupts and status signals

The sampling equipment can be interrupted by voluntary action or unintentional incidents such as defects.
The interruptions in the sampling must be registered with the time of begin and end.
The cause of the interruption in sampling must be traceable from the registered data or from the logbook.

4.5 Availability

A minimum availability of 95%, relative to the actual period of operation of the installation is feasible with the actual instruments.

The plant owner has to provide a registration of the operation time of the combustion plant, in order to enable the continuity of the sampling. This registration is not required as a part of the dioxin sampler, but it needs to be available to be added to the log of each sampling period, so as to enable the verification of the history of interrupts and the calculation of the sampler's availability.

To fulfil the requirement of continuous sampling at least 90 % of the effective time of operation of the plant shall be covered when a period of one year of operation is considered.

Additionally this 90 % availability is a target value for each individual period that corresponds to an analysis.
If the availability criterion cannot be met however this does not entail that the sample is not valid or need not be analysed.

The control of the instrument shall be conceived to a sampling period that is as complete as possible. For example when a non correctible deviation from the isokinetic sampling rate occurs, the sampling shall not be switched off, but an aspiration that is as close as possible to the required rate shall be maintained. In order to prevent interrupts due to non-isokinetic conditions, eventually the data from table 1 can be used to allow for a more ample range of exceeding the isokinetic rate.

4.6 Cooling

Systems that work according to the cooled probe principle must be able to provide sufficient cooling over the entire sampling period. Registration of the temperature of the cooled gas flow is one way to demonstrate the efficiency of cooling.

5 INSPECTION OF THE DATA REGISTRATION

5.1 Sample volume

The measurement of the sampled gas volume must be sufficiently accurate and calibrated. The volume measurement shall produce a robust integrated value of the total sampled volume at the end of the sampling period, and this measurement shall be independent of interruptions. The necessary parameters of the gas volume measured (pressure and temperature) and the temperature of the condenser shall be known to allow the conversion to normal volume of dry gas.
For reporting the results it is only necessary that a daily collected sample volume is available (in standard conditions, with the corresponding average oxygen concentration, or corrected to the reference oxygen concentration).
For the check of isokinetic sampling by the expert however the reading of sample volumes over selected shorter periods of time should be possible.
Additionally all parameters that are used for the calculation of isokinetism have to be available (i.e. either be directly readable, measurable or to be calculated by the expert himself). Concretely this involves the gas conditions, pressure, temperature, water content and flow in the chimney and in the sampling system.

5.2 Flue gas velocity

The flue gas velocity is a primary input for the control of isokinetic control of the sample rate, and therefore has to be measured.
In some cases the instrument will use a minimum velocity as a threshold above which the sampling is switched on.
Registration of the flue gas velocity per hour in an electronic data file is therefore desirable to enable traceability of isokinetic control conditions and duration of sampling.

5.3 Oxygen concentration

In order to express the final result at the reference oxygen concentration (e.g. 11% O_2) a continuous oxygen analyser has to be available.
The oxygen concentration in the flue gas also is an indicator whether the combustion is in operation or not.
The signal of the continuous emission measurement system of the combustion plant can be used for the dioxin sampling, on the condition that no intermediate dilution takes places (and that the oxygen instrument is well calibrated and approved).

5.4 Other data to be registered

All essential data about the operation of the sampling equipment and the process shall be traceable after the sample is taken.
In each case the following have to be registered:
- The volume of the sample with all pertinent condition variables,
- All parameters that demonstrate the correct operation of the sampling
  (temperature of cooled probe and/or cooling, isokinetic rate…)
- All parameters that are used to command starts and stops

6 TREATMENT OF SAMPLES

In principle the sample includes a filter, a solid adsorbent, a condensate and the washings of the probe.
With the actually available systems at the end of the sampling period one combined sample is obtained, consisting of a glass cartridge with glass wool plug and XAD-2 adsorbent. The condensate fraction has been percolated over the XAD-2 and is not further analysed.
If the probe is not washed and the dust is not recovered from the probe to be added to the sample, then it is up to the plant operator to demonstrate that this deviation is acceptable for his installation.

This proof can be achieved by a thorough cleaning of the complete probe and sample line after a sampling period of 2 weeks, collection of all dust deposits and washings, followed by analysis of PCDDs and PCDFs. For the recovery of deposited dust a brush or filter paper shall be used, followed by solvent washing. If the result is higher than 15 % of the total TEQ (this is the sum of this fraction and the analysis of the cartridge for the same period) than it is not allowable to analyse exclusively the glass wool plug and the XAD-2 resin. Strictly the 15% TEQ condition only applies at the emission guide value of 0,1 ng

TEQ/Nm³. The expert can motivate a deviation to higher percentages, on the basis of continuous low values.

The preceding test shall be executed in conditions where it is expected that the largest fraction of dioxins occurs in the particulate fraction, namely when emission have higher dust concentrations and lower flue gas temperatures.

7 TEST ON COMPARABILITY WITH THE REFERENCE METHOD

The reference method EN1948-1 is defined for sampling periods of at least 6 and at most 8 hours.

A proper test of comparability with a complete series of (42 to 56) measurements with the reference method is in the views of the working group not efficient and therefore this is not required.

In principle it is assumed that through application of the technical prescriptions of the manufacturer and this code, all precautions were taken to assure that the results of the continuous sample be the same as the sum of all consecutive samples according to EN-1948 during the same period.
In particular in the long term samples, the losses from incomplete recovery of the sample, breakthrough or degradation have to be avoided according to the state of the knowledge.

Further non controllable differences with the reference method (e.g. eventual limited losses due to lack of stability) are inherent in the method of long term sampling.
Practical experience on many different installations in Flanders in the mean time has demonstrated that the results of 14-day samples are sufficiently functional to detect relevant deviations of the dioxin emissions.

8 SUMMARY: ELEMENTS FOR INSPECTION AND APPROVAL

8.1 Checklist for the expert

The inspection by the expert shall take place at the moment of exchange of samples. In this way the instrument can be stopped without consequences for the quality of the sample. At this time the instrument can be inspected, the starting and stopping procedures can eventually be tested, and starts and stops can be simulated.

The inspection by an independent expert shall imply the following elements:

- check of type approval report (TüV, mCerts) or foregoing test programs of the set up
- check of suitability and representativity of the measurement plane
- description of the system including checks and controls (P, T, Q)
- test of function of measuring and working parts
- visual inspection of eventual fractures, leaks or other damage
- perform or inspect a leak test; minimal frequency of leak testing is at each change of sample
- check the volume measurement by means of calibration documents or comparative measurements of the gas meter
- perform a calculation check of the isokinetic sampling rate
- verification of data registration
- audit of maintenance procedures and operation procedures
- check of protection against unauthorized interventions

8.2 Points of interest for the operator

In order to facilitate the approval of the continuous dioxin sampling equipment the following points of interest concern the operator or the person responsible for this equipment.

- The position of the sampling plane in the flue gas duct is at least conform with the Belgian standard for volume flow measurement NBN T95-001, i.e. situated in a straight and undisturbed stretch of duct of 6 D_h long, 4 D_h of which are upstream the sample plane
- Openings for comparative measurements of temperature, gas velocity etc. shall be available close to the instruments sample section. It must be possible to perform both measurements simultaneously
- A criterion for the operation of the combustion plant has to be formulated relative to the continuous dioxin sampling. These parameters can be different for different plants.
- The operation of the combustion plant has to be registered in order to demonstrate that the sampling equipment has been sampling during the whole period op operation
- The integrity of the samples needs to be guaranteed; one factor that can contribute to this is the allocation of a unique code to every adsorbent cartridge and the registration of this code in the log book at the beginning of the sampling period
- A log book – or similar traceable recording – is to be kept of the history of the sampling system
- The elementary sampling data (temperature, status signals, sample volume and time) need to be preserved during at least 3 years to allow verification by the expert
- During the visit of the expert the person responsible for the change of samples and the operation of the system shall be available.