

# Technical requirements for the ACTRIS Aerosol In-Situ variable “Mass concentration of particulate organics”

Centre for Aerosol In-Situ – European Centre for Aerosol  
Calibration and Characterization (CAIS-ECAC)

OrGanic Tracers and Aerosol Constituents - Calibration  
Centre (OGTAC-CC)

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# 1 About this document

The pan-European aerosol, clouds and trace gas research infrastructure (ACTRIS) aims at producing high-quality data sets for short lived atmospheric constituents. One of the major missions is the harmonization of measurements techniques between the individual National facilities (NFs) to ensure the generation of comparable, traceable and quality assured and quality-controlled data.

In the framework of ACTRIS, OGTAC-CC as a Topical centre unit of the Centre for Aerosol In-Situ Measurement – European Center for Aerosol Calibration and Characterization (CAIS-ECAC) provides service and support for the analysis of organic tracers and aerosol constituents, from particles collected on filters or impactor substrates. The structure of the central facility with its sub-unit TCs is shown in Figure 1.

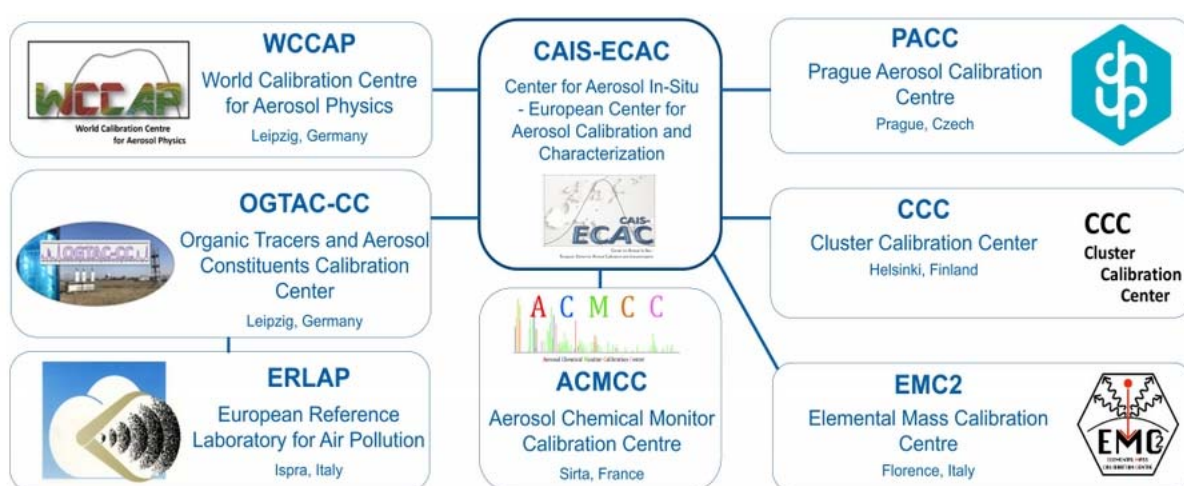


Figure 1: Structure of the CAIS-ECAC consortium, consisting of seven facilities (<https://www.actris-ecac.eu/>).

The document "Technical requirements" considers guidelines and recommendations developed in close collaboration with the ACTRIS community based on former and current research. It provides an overview about general technical requirements to be met if NFs aiming on the measurement of organic tracers and aerosol constituents as one of the additional variables within the aerosol in-situ framework. This document considers recommendations from other long-term observational networks, e.g., from WMO-GAW, EMEP EUSAAR. The extended recommendations and specifications in this document serve as a basis for the evaluation of NFs in the course of the initial labelling phase and are the base for the measurement guidelines provided by OGTAC-CC.

## 2 Supported target compounds

At the current stage, OGTAC-CC supports a list of target analytes categorized in 7 modules, summarized in Table 1.

Table 1: List of target compounds supported by OGAC-CC.

| Module                  | Target compounds                                     | Module                  | Target compounds         |
|-------------------------|------------------------------------------------------|-------------------------|--------------------------|
| 1) Biomass burning      | Levogluconan                                         | 6) SOA – nitroaromatics | 2-Nitrophenol            |
|                         | Mannosan                                             |                         | 4-Nitrophenol            |
|                         | Galactosan                                           |                         | 2,4-Dinitrophenol        |
| 2) Primary biogenic     | Erythritol                                           |                         | 3-Nitrocatechol          |
|                         | Arabitol                                             |                         | 4-Nitrocatechol          |
|                         | Glucose                                              |                         | 2-Methyl-4-nitrophenol   |
|                         | Fructose                                             |                         | 4-Nitroguaiacol          |
|                         | Mannose                                              |                         | 4-Methyl-5-nitrocatechol |
|                         | Galactose                                            |                         | 3-Methyl-5-nitrocatechol |
|                         | Mannitol                                             | 7) PAHs                 | Naphthalene              |
|                         | Ergosterol                                           |                         | Acenaphthylene           |
| 3) Organic ions         | Oxalate                                              |                         | Acenaphthene             |
|                         | Formate                                              |                         | Fluorene                 |
|                         | Methane sulfonic acid                                |                         | Phenanthrene             |
| 4) Biogenic SOA – acids | Terebic acid                                         |                         | Anthracene               |
|                         | Vanillic acid                                        |                         | Fluoranthene             |
|                         | Isovanillic acid                                     |                         | Pyrene                   |
|                         | MBTCA                                                |                         | Benzo[a]anthracene       |
|                         | Norpinonic acid                                      |                         | Chrysene                 |
|                         | Pinic acid                                           |                         | Benzo[b]fluoranthene     |
|                         | Pinonic acid                                         |                         | Benzo[k]fluoranthene     |
| 5) SOA – aldehydes      | Vanillin                                             |                         | Benzo[a]pyrene           |
|                         | Syringaldehyde                                       |                         | Indeno[1,2,3-cd]pyrene   |
|                         | Coniferyl aldehyde                                   |                         | Benzo[g,h,i]perylene     |
|                         | Acetosyringone (3,5-dimethoxy-4-hydroxyacetophenone) |                         | Dibenzo[a,h]anthracene   |

The full technical workflow comprises particle sampling at ACTRIS NFs, followed by sample transport, preparation, storage, until the final chemical analysis of the produced extracts in the laboratory. The minimum requirement for the OGAC-CC aerosol in-situ label is to provide on a regular base 2 target compounds from one or more modules. However, this does not limit the outcome of the analytical method. Since analytical methods for organic compounds can typically determine several of the listed analytes in parallel, the recommendation is to determine as standard the maximum outcome from one analytical procedure.

It should be mentioned that OGAC-CC is open for new developments in both aerosol particle sampling techniques as well as analytical systems and methods to further improve the determination of particulate organics. New instrumentation will be thoroughly tested by the calibration centre together with the NFs, for example by regular interlaboratory comparisons. Furthermore, it has to be noted, that the enrolment of further individual analytes not yet listed in Table 1 will be evaluated on an annual base if sufficient experimental data for full quality control is collected by the calibration centre.

OGAC-CC will support and service all NFs within ACTRIS to ensure high data quality. The present technical requirements document aims to provide a guideline to harmonize the full technical process between the NFs by defining the minimum prerequisites for sampling sites, sampling techniques,

sample handling as well as laboratory equipment for the collection and analysis of particulate organic tracers.

### 3 Data Quality Objectives

Data quality objectives (DQOs) define the type, quality and quantity required of primary data and derived parameters to yield information that can be used to support decisions. In particular, DQOs specify tolerable levels of uncertainty in the data, required completeness, comparability and representativeness based on the decisions to be made.<sup>1</sup>

The DQOs in the present document are a compromise between the scientific need, the chemical (and physical) properties of interest of the target compounds and the existing instrumentation. The main general DQOs are summarized in Table 2, whereas module specific figures of merit are listed in Table 3.

Table 2: General Data Quality Objectives (DQOs) for organic tracers and aerosol constituents.

| DQO                                | Description                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sampler                            | High- or Low-volume sampler and cascade impactors according to DIN EN 12341:2023-10. <sup>2</sup>                                                                                                                                                                                                                                                       |
| Field blank sampling               | Minimum number shall correspond to 5% of the number of real measurement samples or minimum once a month.                                                                                                                                                                                                                                                |
| Measurement time (data resolution) | It is recommended to measure on a continuous basis, minimum requirement is a weekly sample or one sample per week. Exceptions: intensive measurement campaigns with a minimum requirement of 5 samples per campaign with two campaigns per year (ideally in two different seasons), need to be individually discussed with the calibration centre (CC). |
| Analytical instrument calibration  | 5 concentration levels, measured as triplicate                                                                                                                                                                                                                                                                                                          |
| Maximum laboratory bias            | Module dependent – see the measurement guidelines documentation                                                                                                                                                                                                                                                                                         |
| Limit of detection                 | Module dependent – see the measurement guidelines documentation                                                                                                                                                                                                                                                                                         |
| Data coverage                      | ≥ 80% of the planned yearly activity. Technical issues and maintenance to be done by the manufacturer are excluded.                                                                                                                                                                                                                                     |
| Data provision                     | Beginning of the next year for the full year before:<br>1) submission to the CC - Deadline 31 <sup>st</sup> of March<br>2) submission to the DC - Deadline 31 <sup>st</sup> of May                                                                                                                                                                      |
| Interlaboratory comparisons        | Participation in biennial module-specific (see Table 1) ILCs and stay within the maximum laboratory bias, the ILC data is discussed with the participants in a workshop after the data is assessed.                                                                                                                                                     |

In any case, the NF must ensure that the operation of the technical part is organized in that way, that everything impacting the quality of the data is well monitored, documented and considered in the data control process.

## 4 Terms and definitions

For the purpose of this technical requirements documentation, the following terms and definitions apply:

### *Field blank sample*

Filter/ substrate sample that is subjected to the entire sampling procedure (sample pretreatment, transfer, mounting in the sampling device) without switching on the sampling device and subsequently processed like a real measurement sample.

### *Maximum laboratory bias*

The laboratory bias, in this context, is the deviation of the measured concentration of a single laboratory compared to the median concentration of other participating laboratories for the same sample in the same interlaboratory comparison. Maximum values for the acceptable laboratory bias are set based on the results from interlaboratory comparisons published in the scientific literature or performed by the calibration centre itself to ensure the data quality expected within ACTRIS. OGTAC-CC will conduct biennial module-specific interlaboratory comparisons to ensure that NFs and associated laboratories fulfill the requirements.

### *Limit of detection*

The Limit of Detection (LOD) is the lowest concentration of an analyte that can be reliably distinguished from the background noise or a blank sample with a specific level of confidence. Independent of the applied technique, a minimum sensitivity for each analyte is defined in the DQO, which must be achieved in order to ensure that typical mass concentrations of organic tracers can be detected with appropriate analytical quality.

### *PM<sub>10</sub>; PM<sub>2.5</sub>; PM<sub>1</sub>*

Means particulate matter which passes through a size-selective inlet as defined in the reference method for the sampling and measurement of PM<sub>10</sub>, EN 12341<sup>2</sup>, with a 50% efficiency cut-off at 10 µm, 2.5 µm or 1 µm aerodynamic diameter, respectively.

## 5 Symbols and abbreviations

|           |                                                                                                       |
|-----------|-------------------------------------------------------------------------------------------------------|
| ACTRIS    | Aerosol, Clouds and Trace Gases Research Infrastructure                                               |
| CAIS-ECAC | Centre for Aerosol In-Situ measurement – European Center for Aerosol Calibration and Characterization |
| CC        | Calibration Centre                                                                                    |
| DQO       | Data Quality Objective                                                                                |
| EMEP      | European Monitoring and Evaluation Programme                                                          |

|           |                                                                                |
|-----------|--------------------------------------------------------------------------------|
| EPA       | Environmental Protection Agency                                                |
| EUSAAR    | European Supersites for Atmospheric Aerosol Research                           |
| HPAEC-PAD | High Performance Anion Exchange Chromatography – Pulsed Amperometric Detection |
| LOD       | Limit of Detection                                                             |
| NF        | National Facility                                                              |
| OGTAC-CC  | Organic Tracers and Aerosol Constituents – Calibration Centre                  |
| PAH       | Polycyclic Aromatic Hydrocarbon                                                |
| PM        | Particulate Matter                                                             |
| SOA       | Secondary Organic Aerosol                                                      |
| WMO-GAW   | World Meteorological Organization – Global Atmosphere Watch                    |

## 6 Technical requirements for particle sampling

This chapter describes the technical requirements that need to be met by ACTRIS observational platforms in order to provide particulate organics data within ACTRIS. After a brief description of general aerosol sampling recommendations, further details regarding the full aerosol particle sampling procedure, e.g. on particle samplers, filter material, filter transfer and storage and system checks are provided.

### 6.1 General aerosol sampling recommendations

All information about general aerosol sampling, aerosol inlet design under consideration of the individual NF circumstances and aerosol conditioning are described in the overall document “**ACTRIS Standard Procedures for In-Situ Aerosol Sampling, Measurements, and Analyses at ACTRIS Observatories**” (<https://www.actris-ecac.eu/actris-gaw-recommendation-documents.html> (03.06.2026)<sup>3</sup>).

### 6.2 Aerosol particle samplers (offline)

The offline filter-based collection of aerosol particles can be done within the PM<sub>10</sub>, PM<sub>2.5</sub> or PM<sub>1</sub> size fraction, either by High-Volume or Low-Volume sampling devices. The calibration centre is not regulating the manufacturer and type of instrument. However, the sampling system has to in agreement with the CAIS-ECAC aerosol sampling recommendations<sup>3</sup> and the general WMO/GAW “Aerosol Measurement Procedures, Guidelines and Recommendations”<sup>4</sup> with respect to sampler and inlet design. The handling of the particle sampler device should be done following the manufacturer’s instructions.

Typical filter sizes are 47 mm and 150 mm, respectively. Further details about the general collection of particulate matter on filters are given in DIN EN 12341:2023-10 <sup>2</sup> and completed by VDI 2463 Blatt 1.<sup>5</sup>

In addition to filter sampling also cascade impactors are suitable for aerosol particle sampling and subsequent particulate organic analysis. The sampling system should be handled similar to the guidelines for filter-based particle collectors.

Important for the operation of the particle samplers is to continuously record the experimental parameters flow rate ( $\text{L min}^{-1}$ ) or volume ( $\text{m}^3$ ) of sampled air and temperature (K). Eventually, respective measurement devices and data logger are required.

The general application of a denuder system prior the aerosol particle sample inlet is not requested for the determination of the particulate organic marker compounds. The NF only has to document in detail if a denuder system is applied, for example if sampling for the determination of particulate OC/EC is done in parallel.

## 6.3 Filter material and impactor substrate

For storage of clean filter material and impactor substrates a clean shelter is required in the lab and at the measurement station if on-site storage is needed. This can serve also as additional clean environment for eventual on-site filter preparation, sample handling and documentation steps.

In general, two types of filter material, Teflon filters and quartz fibre filters, are recommended following the WMO/GAW guidelines<sup>4</sup>. Depending on the measurement, glass fibre filters are also applicable.<sup>5-8</sup> If a station uses other types of filter it is mandatory to prove the applicability by, e.g. parallel measurements for a certain timeframe that has to be discussed individually with the CC.

Impactor substrates are typically aluminum foil, Teflon filters and polycarbonate filters depending on the purpose of sampling.<sup>4</sup>

## 6.4 Sample pre-treatment, storage and transfer

This section summarizes all required instrumentation regarding sample pre-treatment, storage and transfer of measurement samples, either filter samples or impactor substrates. Weighing of filter/impactor substrate samples is not required for the determination of particulate organics. However, the CC highly encourage the observatories to include the particulate mass determination within their measurement procedure. Therefore, required material is listed as optional information.

- A fridge or freezer at the measurement site, for temporal storage after sampling until samples are transferred for chemical analysis or analyzed, respectively.
- Sample storage and transfer always protected from external contamination and in the dark, e.g. in light protected boxes wrapped in aluminum foils or in zip-lock bags, clean glass petri dishes or similar containers
- Sample transfer boxes with the option of cooling, minimum requirement is to keep the temperature during transport below 20°C.
- Filter manipulation always with new gloves (anti-static and powder free) and cleaned tweezers

- Ultrapure water ( $R \geq 18.2 \text{ M}\Omega \text{ cm}$ ) is required for regular cleaning of equipment and to prepare water blanks. Ideally, infrastructure for supply and quality control of deionized water is available at site. Alternatively, clean water can also be brought in canisters or bottles, but purity must be assured.
- Organic solvents (isopropanol or ethanol) are required in sufficient purity for hardware cleaning purposes (e.g., cleaning of filter holders).

Optional: summary of the main requirements for weighing facilities, more details given in DIN EN 12341<sup>2</sup>:

- Climate controlled weighing room
- Temperature and humidity sensors for monitoring the conditions
- Clean air unit for storage during equilibration
- Balance with a resolution  $\leq 10 \mu\text{g}$
- Weighing standard protocol (see measurement guidelines)

## 6.5 Sampling system control and maintenance

- Sensors for temperature (ambient and in filter section), pressure, flow rate and sampling time during the sampling for sample volume and size cutoff control
- Temperature sensor for monitoring the storage temperature in the sampling device (if available)
- Data logging unit
- Suitable devices for system calibration and maintenance procedures according to the manufacturer's instructions (e.g. rotameter)

## 6.6 Additional requirements at the field site

- If any filter manipulation is done at the field site, a clean work area (workbench with clean surface) is required, plus cleaned devices for all performed steps (laboratory standard), ideally in a filtered flow hood or glove box (particle-free air)
- Necessary equipment for comprehensive documentation of all sampling steps and special occurrences which is needed for reporting and potential flagging of data

## 7 Technical requirements for laboratory analysis

### 7.1 General remarks

The ACTRIS variable “organic tracers” is measured offline from aliquots of filter or impactor substrate samples. For the quantification of organic tracers there are several analytical techniques with different suitable configurations, including chromatography columns or detectors from various suppliers. OGTAC-CC does not explicitly specify which manufacturer, instrument or chromatographic column have to be used for laboratory analysis. However, data quality objectives for each analyte (group) are defined and must be achieved in order to ensure NFs capabilities to measure typical organic tracer concentrations with appropriate analytical quality. Regular interlaboratory comparisons (ILCs) will be conducted to identify potential methodological deviations between NFs as a measure of quality control.

### 7.2 Recommended and supported analytical techniques

Table 3 summarizes the recommended and supported analytical techniques by OGTAC-CC and the corresponding figures of merit to be met for the determination of particulate organics. Based on the ILCs conducted and evaluated to date, these have been established for module 1 and will be updated accordingly for all subsequent modules.

Table 3: Recommended and supported analytical techniques and analytical figures of merit to be met for the determination of particulate organic tracers.

| Module and target compounds                          | CAS number                   | Recommended and supported analytical technique | Maximum laboratory bias | Analytical limit of detection [mg L <sup>-1</sup> ] |
|------------------------------------------------------|------------------------------|------------------------------------------------|-------------------------|-----------------------------------------------------|
| 1) Biomass burning                                   |                              |                                                |                         |                                                     |
| Levoglucosan                                         | 498-07-7                     | HPAEC-PAD                                      | 20%                     | 0.05                                                |
| Mannosan                                             | 14168-65-1                   |                                                | 20%                     | 0.05                                                |
| Galactosan                                           | 644-76-8                     |                                                | 20%                     | 0.1                                                 |
| 2) Primary biogenic                                  |                              |                                                |                         |                                                     |
| Erythritol                                           | 149-32-6                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Arabitol                                             | D=488-82-4;<br>L=7643-75-6   | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Glucose                                              | D=50-99-7;<br>L=921-60-8     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Fructose                                             | D=57-48-7;<br>L=7776-48-9    | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Mannose                                              | D=3458-28-4;<br>L=10030-80-5 | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Galactose                                            | D=59-23-4;<br>L=15572-79-9   | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Mannitol                                             | D=69-65-8;<br>L=643-01-6     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Ergosterol                                           | 57-87-4                      | Tbd.                                           | Tbd.                    | Tbd.                                                |
| 3) Organic ions                                      |                              |                                                |                         |                                                     |
| Oxalate                                              | 338-70-5                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Formate                                              | 71-47-6                      | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Methane sulfonic acid                                | 75-75-2                      | Tbd.                                           | Tbd.                    | Tbd.                                                |
| 4) Biogenic SOA - acids                              |                              |                                                |                         |                                                     |
| Terebic acid                                         | 79-91-4                      | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Vanillic acid                                        | 121-34-6                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Isovanillic acid                                     | 645-08-9                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| MBTCA                                                | 77370-41-3                   | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Norpinonic acid                                      | 473-68-7                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Pinic acid                                           | 473-73-4                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Pinonic acid                                         | 473-72-3                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| 5) SOA - aldehydes                                   |                              |                                                |                         |                                                     |
| Vanillin                                             | 121-33-5                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Syringaldehyde                                       | 134-96-3                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Coniferyl aldehyde                                   | 458-36-6                     | Tbd.                                           | Tbd.                    | Tbd.                                                |
| Acetosyringone (3,5-dimethoxy-4-hydroxyacetophenone) | 2478-38-8                    | Tbd.                                           | Tbd.                    | Tbd.                                                |
| 6) SOA - nitroaromatics                              |                              |                                                |                         |                                                     |
| 2-Nitrophenol                                        | 88-75-5                      | Tbd.                                           | Tbd.                    | Tbd.                                                |
| 4-Nitrophenol                                        | 100-02-7                     | Tbd.                                           | Tbd.                    | Tbd.                                                |

|                          |            |      |      |      |
|--------------------------|------------|------|------|------|
| 2,4-Dinitrophenol        | 51-28-5    | Tbd. | Tbd. | Tbd. |
| 3-Nitrocatechol          | 6665-98-1  | Tbd. | Tbd. | Tbd. |
| 4-Nitrocatechol          | 3316-09-4  | Tbd. | Tbd. | Tbd. |
| 2-Methyl-4-nitrophenol   | 99-53-6    | Tbd. | Tbd. | Tbd. |
| 4-Nitroguaiacol          | 3251-56-7  | Tbd. | Tbd. | Tbd. |
| 4-Methyl-5-nitrocatechol | 68906-21-8 | Tbd. | Tbd. | Tbd. |
| 3-Methyl-5-nitrocatechol | 5378-76-7  | Tbd. | Tbd. | Tbd. |
| 7) PAHs                  |            |      |      |      |
| Naphthalene              | 91-20-3    | Tbd. | Tbd. | Tbd. |
| Acenaphthylene           | 208-96-8   | Tbd. | Tbd. | Tbd. |
| Acenaphthene             | 83-32-9    | Tbd. | Tbd. | Tbd. |
| Fluorene                 | 86-73-7    | Tbd. | Tbd. | Tbd. |
| Phenanthrene             | 85-01-8    | Tbd. | Tbd. | Tbd. |
| Anthracene               | 120-12-7   | Tbd. | Tbd. | Tbd. |
| Fluoranthene             | 206-44-0   | Tbd. | Tbd. | Tbd. |
| Pyrene                   | 129-00-0   | Tbd. | Tbd. | Tbd. |
| Benzo[a]anthracene       | 56-55-3    | Tbd. | Tbd. | Tbd. |
| Chrysene                 | 218-01-9   | Tbd. | Tbd. | Tbd. |
| Benzo[b]fluoranthene     | 205-99-2   | Tbd. | Tbd. | Tbd. |
| Benzo[k]fluoranthene     | 207-08-9   | Tbd. | Tbd. | Tbd. |
| Benzo[a]pyrene           | 50-32-8    | Tbd. | Tbd. | Tbd. |
| Indeno[1,2,3-cd]pyrene   | 193-39-5   | Tbd. | Tbd. | Tbd. |
| Benzo[g,h,i]perylene     | 191-24-2   | Tbd. | Tbd. | Tbd. |
| Dibenzo[a,h]anthracene   | 53-70-3    | Tbd. | Tbd. | Tbd. |

## 7.3 Sample handling and sample preparation in the laboratory

This paragraph lists necessary equipment for all steps after the sample arrival at the laboratory until its chemical analysis, including storage, transfer and filtration. The calibration centre requests that all applied hardware can be clearly identified by the documentation provided by the NF. Additionally, details about the respective procedure have to be provided. The CC requested content is part of the measurement guidelines.

The following equipment is required:

- Clean laboratory rooms for trace-level chemical analysis.
- Laboratory equipment and workplaces to avoid cross-contamination with potentially highly concentrated substances.
- Space in a fridge or preferably freezer for sample storage. Samples must not be stored together with volatile substances or samples that may contain such components to avoid cross contamination.
- Laboratory gloves to protect samples from contamination.
- Filter punch

- Disposable laboratory items, e.g. syringes, filtering equipment, extraction vessels, sample vials, caps, pipette tips.
- Laboratory shaker and/ or an ultrasonic bath
- Filtration equipment or centrifugation
- Enrichment methods like evaporation until dryness and resolution or the application of a solid phase extraction, also for cleaning purposes (optional)
- A supply of pure deionized water ( $R \geq 18.2 \text{ M}\Omega \text{ cm}$ ) is recommended for cleaning of equipment, sample containers and preparation of blank samples.
- Oven for the drying of cleaned equipment (optional).

The following chemicals are required:

- Ultrapure water ( $R \geq 18.2 \text{ M}\Omega \text{ cm}$ ).
- Extraction solvents with sufficient purity according to the applied analytical procedure.
- Derivatization agents with sufficient purity according to the applied analytical procedure.
- Commercially available standards (labelled or non-labelled) are recommended for calibration or as internal standard solution, self-synthesized standards need to be approved by the CC.

## 7.4 Analytical equipment

The full analytical procedure in general needs a chromatographic separation system consisting of an autosampler, an injection device, a mobile phase, a separation column and a detection unit. Details about the needed analytical equipment can be found in the respective module specific "measurement guidelines document".

*Chemicals and accessories:*

- Laboratory space with respective safety requirements for trace level chemical analysis
- Ultrapure water, specific resistance  $\geq 18.2 \text{ M}\Omega \text{ cm}$
- Solvents and/or gases with sufficient purity according to the applied analytical procedure
- Pure standard compounds with sufficient purity according to the recommended analytical procedure
- Technical accessories according to the applied analytical procedure, e.g. filtration devices for the mobile phase in LC

# 8 QA/QC

## 8.1 Interlaboratory comparisons

The goals of the biennial module specific interlaboratory comparisons (ILCs) are:

- Evaluation comparability of laboratories in the network
- Identify problems for individual NFs

- Reveal potential problems so that corrective action can be taken
- Experimental basis to validate or flag data regarding the DQOs

Every two years OGTAC-CC will send around a selection of samples and standards to be analyzed by participating (NF-) laboratories, to evaluate their performance. The sample set will be prepared at OGTAC-CC and send to the participants in insulated boxes with dry ice to avoid degradation. NFs are expected to submit analysis results within 12 weeks after arrival. The scheduling of exact sample shipping dates and reporting deadlines will be coordinated with participating NFs and specified in the regular QA/QC workshops.

## 8.2 Workshops and community meetings

OGTAC-CC organizes yearly QA/QC workshops, typically scheduled at the beginning of the year after submission of the data to the CC and before the submission deadline to the ACTRIS data centre to address the following topics:

- Results from the latest interlaboratory comparison (if conducted)
- Discussion of the data quality provided by the NFs
- Q/A with OGTAC-CC

Furthermore, every two years (or on special request) OGTAC-CC will host community meetings to discuss all potentially relevant topics with respect to particulate organics.

- Update on OGTAC-CC status and developments
- Results from interlaboratory comparisons
- NF reports and updates to protocols and instrument setups
- Questions to OGTAC-CC
- Possibilities for combined research efforts
- Announcements of new community activities

## 8.3 Procedure

For each ILC OGTAC-CC will provide detailed instructions, schedule and a reporting template in advance. An ILC sample-set comprises different samples, which are labelled with ID-codes and include different sample types:

- At least one blank sample is included to evaluate background signals of NF specific sample preparation methods (e.g. filter, vial, pipette tips) and analytical equipment.
- A series of real filter samples provided by OGTAC-CC to test matrix effects and potential interferences. Some of them could also be spiked with known concentrations of target analytes.
- A set of artificial mixtures prepared from certified calibration solutions.

All ILC samples must be handled, prepared and analyzed according to the NF-specific standard operating procedure (SOP). A general assessment via statistical approaches like the z-score is questionable, because of the currently still small number of NFs resulting in not robust enough statistics. Therefore, OGTAC-CC follows for now the GAW guidelines for precipitation chemistry and assesses the data quality via the maximum laboratory bias. These values are target compound (class) dependent and set in the respective module DQOs (Table 3). Here, the results of the real filter samples are used, whereas the results of the synthetic standard solutions are used for the evaluation criteria in the second instance. An ILC participating laboratory fails the QA if: a) the average of all submissions is outside of the DQO (depending on the number of samples) or b) more than 50% of individual submissions are outside of the DQO (depending on the number of samples).

The following order of actions will be undertaken if a participating laboratory fails the QA:

- Laboratory is contacted by OGTAC-CC to identify potential problems
- Data can be reprocessed if software or data treatment issues are identified
- Additional standard control checks can be performed
- Data need to be flagged

If a laboratory successfully participated in the module-specific biennial ILCs, the NF will have to document their instrumental setup, sample preparation and analysis protocols in the corresponding section of the metadata when submitting their yearly measurement results. This helps OGTAC-CC to also identify if there are changes of methods or setups and allow regular checks if entries in the instrument database and metadata for protocols are up-to-date.

## 9 References

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8. EMEP/CCC-Report 1/95; *EMEP manual for sampling and chemical analysis (Revision 2014)*; Norwegian Institute for Air Research: 1996.