Title

STANDARD OPERATING PROCEDURE (SOP) FOR SYSTEM AND PERFORMANCE AUDITS OF ATMOSPHERIC TRACE GAS MEASUREMENTS AT WMO/GAW SITES

Version

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Contributors

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Approval

SAG Greenhouse Gases: approved
SAG Reactive Gases: approved

Scope

This document gives guidelines on how to conduct combined system and performance audits of trace gas measurements at WMO Global Atmosphere Watch (GAW) stations. It is intended for audits of measurement systems that use either a gas chromatographic method and/or continuous gas analysers. This SOP has been optimised for audits of CH_4, CO or N_2O measurements.

Definitions

According to the GAW Strategic Implementation Plan (WMO/GAW Report 142), a *performance audit* is defined as a voluntary check of conformity of a measurement where the audit criteria are the DQOs for that parameter. In the absence of formal DQOs, an audit will at least involve ensuring the traceability of measurements to the Reference Standard. A *system audit* is more generally defined as a check of the overall conformity of a station with the principles of the GAW QA system. The reference for conformity of a station will evolve as the GAW QA system evolves.

Site		Compound
Planned date of audit	Auditor	

Parts of this Document

1 PREPARATION OF AUDIT AT HOME

1.1 Administration

1.1.1 Contact site operator(s), network co-ordinator or other responsible people to determine audit schedule and define audit aims. ❑

1.1.2 Acquire general station information, including information on responsibilities, organisation of station information, the local meteorology, potential pollution sources and, if applicable, about changes in site equipment and/or procedures since last audit. ❑

1.1.3 Request station contacts to have all relevant documentation (log-books, calibration histories, QA data, etc.) available at the station during the audit and possibly beforehand. ❑

1.1.4 Prepare documents required for transport and customs clearance of audit material, especially regarding dangerous goods (gas cylinders) ❑

1.1.5 Advise cargo company well in advance of shipment of audit material ❑

1.1.6 Prepare the audit questionnaire for completion on site. ❑

1.2 Audit Equipment

1.2.1 Prepare and calibrate a suite of transfer/travelling standards. The number of standards and their mole fraction will be determined by the DQOs (if available) or should be chosen according to the variability expected at the site. For example, the following ranges are recommended for CH_4, N_2O and CO. ❑

CH4: 1600 – 2000 ppb
N2O: 290 – 350 ppb (as specified by DQOs)
CO: 50 – 300 ppb (upper limit can be as high as 2000 ppb)

1.2.2 Prepare tubing/connectors for connection between cylinders and GC/monitor for two possible cases: gas is supplied to GC/monitor with or without overflow ❑

1.2.3 Ship all audit equipment including dedicated pressure regulators, log book for pressures of cylinders and accompanying instructions as applicable. ❑

1.3 Measurement Data

1.3.1 Review relevant data and metadata of the station WDCGG and in GAWSIS. Check length of record. Estimate expected variability of audited parameter. ❑

2 AUDIT PROCEDURES ON SITE

2.1 General

2.1.1 Upon arrival, inspect all equipment for transport damage and take action if damage is found. ❑

2.1.2 Sign in the audit team on-site in the station log book. ❑

2.1.3 Install audit equipment and allow sufficient time for conditioning and purging of regulators and lines as well as instrumentation. ❑

2.1.4 Conduct opening meeting for audit. Inform all involved personnel about the time schedule of the audit and the goals. Fix a suitable date/time for the final discussion. ❑

2.1.5 Check the availability on site of documents, data or other important information relevant for conducting the audit, and make arrangements to get missing ones. ❑

2.1.6 While conducting the audit, note the staff's competence in operating and maintaining the station as well as cleanliness and appearance of the site. ❑

2.1.7 Make necessary arrangements for return shipment of audit material. ❑

2.1.8 Fill in the corresponding sections of the audit questionnaire. ❑

2.1.9 Review site description at WDCGG and in GAWSIS. ❑

2.2 Audit of Air Inlet System

2.2.1 Inspect condition and suitability of the air inlet system, in particular with regard to materials used, residence time and location. ❑

2.2.2 Fill in the corresponding sections of the audit questionnaire. ❑

2.2.3 Review description of air inlet at WDCGG and in GAWSIS.

2.3 Audit of Instrumentation

2.3.1 Request the station operator to flag the data acquired during audit appropriately as inter-comparison data and to indicate the start time in the log book. ❑

2.3.2 If possible, connect the first transfer standard to the system instead of ambient air, otherwise use a spare sample port. If ambient air is drawn into the instrument, provide for an adequate over-flow of the standard gas. ❑

2.3.3 Perform regular analyses and record results. Follow the regular sample sequence used at the station with regard to intermittent calibration with their own standard. Make sure the station's own standard is analysed at least once. ❑

2.3.4 **GC systems:** Investigate peak shapes, baseline noise, and resolution in case more than one signal is obtained. Plot a chromatogram. ❑

Continuous analysers: Investigate baseline noise under zero-air conditions and response time after switching between concentrations.

2.3.5 Repeat steps 2.3.2 – 2.3.4 for all standards, including zero-air. ❑

(If a significant difference is found between measured value and nominal value, check all audit equipment for proper connections and operation. Repeat the inter-comparison as appropriate to verify the difference.)

2.3.6 Reconnect the system to the station sampling manifold and check for normal instrument operation. ❑

2.3.7 Inform the station operator of completion of the inter-comparison and request return to normal data flagging. ❑

Request indication of end time in the log book.

2.3.8 Compare the (preliminary) audit results to the data quality objectives (DQOs) if available and determine conformity. ❑

2.3.9 Discuss the intercomparison results with the site operator, emphasising any major deficiencies found and any corrective action required. ❑

2.3.10 Fill in the corresponding sections of the audit questionnaire. ❑

2.3.11 Review metadata entries in WDCGG and in GAWSIS. ❑

Note: In case of longer lasting intercomparisons, these may be continued by the station operators after the presence of the audit team at the site.

2.4 Audit of Data Management and Submission

2.4.1 Review the data management procedures implemented at the site, in particular concerning data integrity, storage, submission to a GAW World Data Centre (WDC) and retrieval of data therefrom. ❑

2.4.2 Review the relevant data archived at the WDC with the station manager. ❑

2.4.3 Fill in the corresponding sections of audit questionnaire. ❑

2.5 Audit of Documentation

2.5.1 Check the organisation, completeness and comprehensiveness of the documentation, in particular, of the maintenance logbook and field logbook. ❑

2.5.2 Fill in the corresponding section of the audit questionnaire. ❑

3 COMPLETION OF AUDIT

3.1 Administration

3.1.1 Summarise the detailed results in a report and send a draft copy for review and approval to the primary station contact. ❑

3.1.2 Submit the approved report to WMO, the responsible GAW Country Contact, the corresponding QA/SAC, as well as the responsible station contact. ❑

3.1.3 If major changes or actions were recommended by the audit report, check the progress being made according to due dates. ❑

3.2 Audit Equipment

3.2.1 Unpack all equipment and supplies and inspect the audit equipment for transport damage. Replenish disposables and fix any damage. ❑

3.2.2 Inter-compare the transfer/travelling standards against GAW laboratory standards. Perform statistical tests to verify that transfer/travelling standards have not changed since last calibration. ❑

4 SUMMARY RATING FOR AUDITED PARAMETER

	inadequate			…		adequate
Site access	❑	❑	❑	❑	❑	❑
Facilities						
Laboratory and office space/equipment	❑	❑	❑	❑	❑	❑
Air conditioning	❑	❑	❑	❑	❑	❑
Power supply for the station	❑	❑	❑	❑	❑	❑
General Management and Operation						
Organisation	❑	❑	❑	❑	❑	❑
Competence of staff	❑	❑	❑	❑	❑	❑
Air inlet system	❑	❑	❑	❑	❑	❑
Instrumentation	❑	❑	❑	❑	❑	❑
Standards	❑	❑	❑	❑	❑	❑
Operation and Maintenance	❑	❑	❑	❑	❑	❑
Data Management						
Data acquisition	❑	❑	❑	❑	❑	❑
Data processing	❑	❑	❑	❑	❑	❑
Data submission	❑	❑	❑	❑	❑	❑
Documentation	❑	❑	❑	❑	❑	❑

Audit SOP completed: Date: .....Name:.....