Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment & Conservation

Pollution Prevention Division
(Environment)

Guidance Document

Title: **Guidelines for Ambient Air Monitoring**

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SUBJECT

The ambient air monitoring methods and protocols approved by the department to monitor the air quality in the Province.

OBJECTIVE

To define the terms and conditions that a person is to follow when conducting ambient air quality monitoring in Newfoundland and Labrador. In so doing, the department ensures that the quality of all results obtained and submitted to the department are complete and consistent across all ambient air monitoring stations and employ the latest technological advances.

BACKGROUND

Large industrial facilities in the province, particularly industries utilizing combustion process equipment, are required to establish an ambient air monitoring program for the purpose of ensuring that emissions of air contaminants are less than the maximum permissible standards as set forth in the *Air Pollution Control Regulations* 39/04. The data collected from the ambient air monitoring program is used for human health risk assessments; public awareness; ensuring environmental compliance in accordance with guidance document GD-PPD-009.3 is achieved and maintained; and validation of compliance modelling. With the advent of new and improved monitoring technologies, and the ever increasing monitoring requirements being placed on a person, it has become imperative for the Department to establish a standard protocol to ensure that all air quality is monitored in a way that is consistent, complete and comparable across all industrial sectors.

Section 21 of the *Air Pollution Control Regulations* dictates that all measurements, recordings and analysis conducted under the regulations are performed by devices and methods acceptable to the Department. This guidance document defines the acceptable ambient air quality monitoring devices and methods to be used in Newfoundland and Labrador. It replaces the rescinded policy document PPD: 98-01.

DEFINITIONS

In this guidance document:

(a) "air contaminant" means any discharge, release, or other propagation into the air and includes, but is not limited to, dust, fumes, mist, smoke, particulate matter, vapours, gases, odours, odorous substances, acids, soot, grime or any combination of them;

(b) "ambient air" means the portion of the atmosphere which is external to buildings, structures or underground spaces;

(c) "combustion process equipment" means a furnace, boiler, dryer, apparatus, stack and all appurtenances used in the combustion process but not including mobile internal combustion engines used to provide propulsion;

(d) "department" means the Department of Environment and Conservation and it's successors;

(e) "DR DAS" means the data acquisition software provided by the DR DAS software company and includes, but is not limited to Envista, Envista ARM, Communication Center and Envidas FW;

(f) "NO_x" means oxides of nitrogen and includes the summation of nitric oxide (NO) and nitrogen dioxide (NO_2);

(g) "person" includes an association of persons, a municipality and the government of the province;

(h) "$PM_{2.5}$" means particulate matter less than or equal to 2.5 microns;

(i) "SO_2" means sulphur dioxide;

(j) "TPM" means total particulate matter;

(k) "US EPA" means the United States Environmental Protection Agency.

1. CRITERIA POLLUTANTS

1.1 Oxides of Nitrogen (NO_x)

In a combustion process, NO_x is produced through 3 mechanisms, namely thermal NO_x, fuel NO_x and prompt NO_x. Thermal NO_x is the primary source of NO_x and is formed as a high temperature dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2). It is produced in the hottest part of the flame and its formation increases exponentially with the flame temperature. The control of thermal NO_x is generally achieved through reducing the flame temperature, reducing the residence time, or by operating under fuel rich conditions. Fuel NO_x is formed by the reaction of nitrogen compounds chemically bound in liquid or solid fuels with oxygen in the combustion air. In the combustion of such fuels, fuel NO_x can account for up to 50% of the total NO_x emissions. Prompt NO_x is formed from the rapid reaction of atmospheric nitrogen with hydrocarbon radicals, and typically under partially fuel-rich conditions. It can be reduced through combustion staging or by operating under highly oxidizing combustion conditions.

NO_2 is the primary component of concern in NO_x emissions. For example, only about 5% of the NO_x emitted from diesel fuel combustion is emitted as NO_2. The remainder is emitted as NO, which is subsequently converted to NO_2 in reactions with various oxidants and oxygen as the plume is transported downwind from the source. The rate of NO_2 formation varies with time of day, season, temperature, wind speed, solar radiation and the availability of oxidants to help drive the chemical reactions.

NO_2 is a reddish brown gas with a pungent odour, which upon reaction with other atmospheric compounds, becomes a major contributor to smog, acid rain, inhalable particulates and reduced visibility. At significant levels and exposure, inhalation may result in irritation and burning to the skin and eyes, nose and throat. Prolonged exposure may result in permanent lung damage.

1.2 Particulate Matter (PM)

Particulate matter is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets, and can be large and dark enough to be seen with the naked eye or so small that they can only be detected with an electron microscope. Many manmade and natural sources emit particulate matter directly while others emit gaseous pollutants that react in the atmosphere to form particulate matter.

The size of the particulate has important health considerations. Particulate matter less than 10 microns in diameter (PM_{10}) poses a health concern because it can be inhaled into and accumulate in the respiratory system. Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is believed to pose the greatest health risks as it can lodge deeply into the lungs; a $PM_{2.5}$ particle is approximately $1/30^{th}$ the average width of a human hair. Typically these smaller particles are suspended in the air for long periods of time. Total Particulate Matter (TPM) is the term applied to any particle suspended in the atmosphere, but depending on the monitoring method, is typically limited to particulate matter less than 44 microns. Particulate larger than 10 microns is typically associated with a nuisance issue rather than a health issue.

1.3 Sulphur Dioxide (SO_2)

Levels of sulphur dioxide (SO_2) in ambient air are directly related to the concentration of sulphur in fuel and the quantity of fuel being combusted. Upon combustion, approximately 98% of the sulphur in the fuel will oxidize to form SO_2, with the remaining 2% producing sulphur trioxide (SO_3). The emitted SO_2 can also further oxidize to SO_3 and react with water to produce acid rain in the form of sulphuric acid (H_2SO_4).

Short-term exposures to SO_2 have shown adverse respiratory effects including bronchoconstriction and increased asthma symptoms.

2. AMBIENT AIR QUALITY STANDARDS

The maximum concentrations of criteria air pollutants considered to be protective of the environment are defined in the *Air Pollution Control Regulations, 2004*. For the pollutants routinely monitored in the province the ambient air quality standards are detailed in Table 2.1.

TABLE 2.1 - AMBIENT AIR QUALITY STANDARDS IN NEWFOUNDLAND AND LABRADOR

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)
Nitrogen Dioxide (NO_2)	1-hour	400
	24-hour	200
	1-year	100
Particulate Matter ≤ 2.5 microns ($PM_{2.5}$)	24-hour	25
Particulate Matter Total (TPM)	24-hour	120
	1-year	60
Sulphur Dioxide (SO_2)	1-hour	900
	3-hour	600
	24-hour	300
	1-year	60

3. APPROVED MONITORS AND METHODS

The monitoring methods for criteria pollutants acceptable to the Department are those which are continuous and are designated as US EPA "reference methods" or "equivalent methods" in accordance with Title 40, Part 53 of the United States Environmental Protection Agency Code of Federal Regulations (40 CFR Part 53). These methods are listed in the US EPA Air Monitoring Methods-Criteria Pollutants "*List of Designated Reference and Equivalence Methods*", as per the link www.epa.gov/ttn/amtic/criteria.html and as updated from time to time, the current version dated August 24, 2010. Methods not on the list are not acceptable unless a preferred method is specified by the Department.

Though the Department will consider all Reference and Equivalence Methods, a list of the preferred methods is available upon request. The monitors are required to be operated and maintained in accordance with, and meet the same absolute performance specifications for the appropriate analytical working range, as delineated in their respective reference or equivalence methods.

EPA method specifications, performance criteria and standard operating procedures established for an EPA approved reference or equivalent method are

subject to modification by the Department in order to enhance monitor performance and improve data quality. The Department reserves the right to modify methods to meet more stringent guidelines and/or performance specifications.

If a variance from an EPA Reference or Equivalent Method is adopted by the Department, written notification will be provided to those affected to adopt accordingly.

All industrial facilities that are required to establish an ambient air monitoring program shall follow the provisions of the *US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program (EPA-454/B-08-003 December 2008)* as updated from time to time.

The monitoring of non-criteria pollutants shall only be conducted after consultation with the Department.

All persons not currently using an approved method are required to upgrade the monitor accordingly by December 31, 2012, unless otherwise approved by the Department.

4. DATA ACQUISITION

The Department requires real-time, on-demand access to raw and diagnostics data. This data may not be modified, manipulated or massaged in any way. The access has to be direct to the data logging device, not to a system which transmits these data files elsewhere and can be altered by built-in algorithms or data functions.

Communication between the central data polling computer and the ambient air monitoring stations for data retrieval shall be accomplished via an IP address or a standard telephone line and fax modem. For data stability purposes, a connection via an IP address is preferred.

The DR DAS software package has been chosen by the Department as our data acquisition-data recovery system. The requirement for a person is to utilize the DR DAS or another software package that is approved by the director and is compatible with the features and functions of DR DAS as specified below. Data acquisition and data recovery must be in the format that is compatible with the DR DAS system. If a person requests utilizing an alternate software package then the person must demonstrate to the Department that the alternate software is compatible with DR DAS before approval is granted by the Director. It is not the Department's responsibility to make other data acquisition software packages

compatible with DR DAS as that is the responsibility of the alternate software package supplier.

Should a person acquire a software package other than DR DAS, then the software package must:

- have a Windows based operating system;
- provide communication between the data recovery Envista software and the data logger at each industrial ambient air monitoring station. Remote connectivity to each station must be available at any time to the Department for data collection and verification purposes;
- provide digital communication between the station datalogger and the monitoring instruments via RS232 or USB connection. Dataloggers that collect data via an analog connection such as Campbell Scientific are not acceptable;
- provide diagnostics data of all monitors utilized in an industrial ambient air monitoring network. As ambient air monitoring raw data is polled from these stations, the diagnostics data, which is the numerical values of the instrument parameter settings during the generation of the raw data, must be simultaneously supplied. This "instrument parameter settings" monitoring indicates when instrument parameter values are degenerating and is therefore a vital data validation/invalidation tool;
- utilize instrument alarms (a.k.a. digital monitors) which can be polled by the Envista software. This allows user-configurable alarm levels to automatically invalidate data that is above or below user-specified values and provide immediate notification when alarm levels are exceeded. This provides automatic data invalidation, minimizes instrument down-time and improves technician response time;
- utilize automated daily zero and span checks for instrument performance verification. The software package must allow these calibration sequences to be configured in order to automatically open and close zero and span valves within the monitors and perform these daily checks. These user-configured sequences should be performed without loss of hourly ambient data. The software package must allow the calibration reports generated from these daily performance verifications to be polled by the Envista software;
- allow communication and data collection from all continuous monitors and be approved as per Section 3 of this guidance document. In particular, the Met One BAM 1020 FEM Configuration monitor, specifically designed for $PM_{2.5}$ monitoring, has unique software functions that have been designed by DR DAS. An alternate software package must have the ability to communicate with this monitor and gather telemetry;
- utilize an electronic logbook.

Information on this software can be found at www.dr-das.com or contact:

DR DAS
194 Clouse Lane
Granville, Ohio 43023
Phone# 740-587-2995

The Department reserves the right to require new DR DAS or equivalent software features as standard operating procedures.

All persons not currently using DR DAS are required to upgrade to this software (or equivalent) by December 31, 2012, unless otherwise approved by the Department.

5. PERFORMANCE AUDITS

Performance audits of industrial ambient air monitoring stations will be conducted on a schedule determined by the Department. The Department may provide notification prior to conducting an audit. A report of the audit findings and required and/or recommended corrective actions will be provided to the respective person subsequent to the audit.

6. ZERO AND SPAN VERIFICATION CHECKS

Zero and span verification checks allow for quantitative assessment of analyzer performance between calibrations. If performed manually, zero and span checks must be performed at least weekly. If the checks are achieved through the DR DAS automatic calibration sequences then the automated zero and span check sequences are to be performed daily, as this would allow for the most clear and precise assessment of trends in analyzer performance. These sequences must occur at a time which prevents loss of hourly data. This is normally achieved by programming the duration of calibration sequences not to exceed twenty minutes and starting them at 10 minutes to the hour and ending 10 minutes after the hour.

As a rule, analyzers should not be re-zeroed following routine zero checks performed during station visits. A correction for a drifting zero may be applied later, at the data validation stage, based on assessment of zero check data for an extended time period. If automated daily zero checks are performed, correction of near-real-time data based on the zero check value for that date is permitted, though cumulative zero data should still be reviewed manually to assess trends and ensure that zeros remain within typical ranges.

Method specifications for EPA approved SO_2 and NO_x methods typically indicate an acceptable zero drift to be ≤0.5 ppb over 24 hours and ≤1 ppb over 7 days. Re-zeroing of monitors is recommended when a zero check indicates a shift of ≥2 ppb in the analyzer zero response. Any such action must be recorded in a permanent logbook, or on log sheets designed for recording analyzer diagnostics and zero/span data. The analyzer should not be re-zeroed a second time if there is a continuation of zero drift in the same direction. Rather, the cause of the zero shift should be investigated. A zero check value obtained using a dilution calibrator and zero air system should confirm whether or not the zero values obtained during routine checks are true analyzer zero responses, or perhaps the result of a depleted scrubber. Also, the operator should disconnect the analyzer's zero air scrubber from the zero port and reconnect it to the sample port to assess if there is any difference in zero response. A lower zero reading on the sample port may indicate an internal leak in zero port plumbing.

Results obtained for routine span checks are assessed against the control values established on the date of the most recent calibration. Clear trends or sudden shifts in analyzer response to the verification standard should be addressed before deviation of span check values from control values exceeds 10%.

7. CONTROL CHARTS

Results obtained from routine span checks are assessed against the span control values established on the date of the most recent calibration. This is accomplished by control charting the daily span checks and comparing with the span control value of the most recent calibration. Clear trends or sudden shifts in analyzer response to the verification standard should be addressed before deviation of span check values from control values exceeds 10%. If the true deviation exceeds 15%, recalibration is mandatory, and collected ambient data from the monitor may be invalidated back to a date where it can be established, with reasonable confidence, that the deviation had not exceeded 15%.

In addition to all the aforementioned calibration criteria, all monitors must be calibrated on a quarterly basis and recorded in the station logbook.

The Department will provide the control chart templates.

8. CERTIFICATION

On a yearly basis, all gas dilution calibrators' mass flow controllers and all primary flow devices deployed in the calibration of particulate and criteria air pollutant monitors, respectively, must be certified.

All certifications must be traceable to the Canadian National Research Council-Institute of National Measurements Standards (NRC-INMS) or the United States National Institute of Standards and Technology (NIST).

A copy of all calibration certifications must be submitted to the Department.

9. UNINTERRUPTIBLE POWER SUPPLIES (UPS)

All ambient monitors, their external pumps and station data loggers / computers (excluding the computer monitor) shall be connected to an uninterruptible power supply (UPS) in order to provide short term battery backup for brief power outages. This will ensure continuous monitoring and prevent the need for resetting these instruments during these brief power outages.

10. SHELTER TEMPERATURE

All ambient air monitoring stations are to be continually maintained and monitored such that the hourly shelter temperature is between 20 C and 30 C. Hourly shelter temperatures outside this range may result in data invalidation.