NORTH DAKOTA
DEPARTMENT *of* HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
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North Dakota Department of Health
Division of Air Quality
Emission Testing Guideline

A. **General**:

Emission testing is required to determine the types and amounts of air pollutants emitted by a variety of emission units in the State of North Dakota. Information gathered from emission testing may be used for several purposes including: enforcing emission limits, issuing permits, evaluating pollution control systems, determining emission inventories, and assessing permit fees.

The purpose of this guideline is to set forth the requirements of a proper test plan and to ensure that test results yield data which are representative, consistent and accurate relative to the tested emission unit(s).

B. **Emission Testing – Planning, Conducting and Reporting**:

The elements of a successful test program include the following:

Submittal of a proposed test plan
Department review of the plan
Pretest meeting with the Department
Department observer on-site during testing
Facility operations and testing
Submittal of a complete test report

Acceptance of emission testing information by the Department is dependent on the facility following the requirements as outlined below. Each requirement should be studied carefully to avoid invalidation of the test by the Department.

1. Submittal of a Proposed Test Plan

A proposed emission test plan must be submitted for each emission unit test at least thirty (30) calendar days in advance of the test date unless otherwise specified by the Department, or by rule (such as 40 CFR Part 63 which requires a 60-day notice). If this schedule cannot be met, the Department should be contacted as soon as possible to work out an agreeable schedule. When preparing a proposed test plan, the format shown in Appendix A should be followed. If any modifications to the accepted or approved plan are to be made, the Department must be notified at least five (5) days prior to the test date.

Prior to submitting the plan, careful consideration must be given to the following:

a. Failure to give proper notification(s) may result in testing which cannot be accepted as valid by the Department.

b. The Department generally requires that all testing be conducted in accordance with methodology promulgated by the Environmental Protection Agency (EPA) in the Code of Federal Regulations. The proposed test plan must clearly identify the test method(s) and include detailed discussion concerning any deviations from the EPA reference methods or other approved procedures if such deviations exist.

c. If a federal regulation is the basis of an emission limit, the specific regulation(s) should be checked before selecting the test method(s). Federal regulations may include a New Source Performance Standard (NSPS), a National Emission Standard for Hazardous Air Pollutants (NESHAP) or a National Emission Standard for Hazardous Air Pollutants for Source Categories (MACT Standard). Emission units subject to a federal regulation must be tested in accordance with EPA methods, sampling times and volumes, and other conditions specified by the regulation.

d. A Permit to Construct or a Permit to Operate may include site-specific test methods and/or test procedures. The proposed test plan must follow all requirements of the applicable permit unless deviations are approved in advance by the Department.

2. Department Review of the Proposed Test Plan

Upon receipt of the proposed test plan, the Department will review the plan for completeness and compliance with specific requirements in permits, regulations, etc. The facility will be contacted as soon as practical if any problems are noted so that they may be resolved prior to testing. Unless advised otherwise, the facility may assume that no changes or modifications will be necessary.

3. Pretest Meeting With the Department

A pretest meeting shall be held if requested by the Department or by the facility. Submittal of a complete proposed test plan and use of test methodology in accordance with EPA reference methods generally alleviates the need for a pretest meeting unless special conditions or circumstances so warrant.

4. Department Observer On-Site During Testing

The Department must be afforded the opportunity to observe any emission testing in the State of North Dakota that is conducted for compliance purposes. Accordingly, the Department must be notified of any changes in test methodology, test dates, or test times in accordance with the requirements in this guideline. If the Department is unable to observe a test due to improper notification by the facility, the test results may be rejected.

5. Facility Operations and Testing

All facility operations and testing must be conducted in accordance with the accepted test plan. Any unforeseen changes due to such things as plant operations or weather must be discussed with the Department. Failure to operate the emission unit or to conduct testing in accordance with the accepted test plan could result in the Department rejecting the test.

Generally, testing must be conducted during emission unit operations where maximum emissions may be expected. This means that testing is to be conducted while operating the emission unit at a level that is at least 90% of design capacity, or at least 90% of the maximum operating rate/level, whichever is greater. Failure to test at the appropriate rate, level, or condition may result in additional restrictions being placed on the emission unit by the Department; this could include a de-rating of the emission unit. Exceptions to the 90% minimum level exist in situations where a relative accuracy test audit (RATA) is conducted on the continuous emission monitoring equipment; during a RATA the minimum acceptable operational level is 50% of capacity.

Testing procedures must follow the applicable reference methods published by the EPA in the Code of Federal Regulations under 40 CFR Parts 51 60, 61 and 63. Specific approval by the Department is necessary for proposed test procedures which include deviations from EPA reference methods or for alternative testing methods.

6. Submittal of a Complete Test Report

An emission test report must be submitted to the Department within sixty (60) days of completion of the test unless otherwise approved by the Department. The report may incorporate, by reference, any material previously submitted to the Department which is part of the accepted test plan, or in subsequent correspondence with the Department. The Department will review the report and will notify the facility of any problems with the report. A suggested report format, including a listing of the minimum data requirements, is shown in Appendix B.

C. **Test Invalidation Criteria**:

An emission test for compliance purposes must be validated by the Department prior to acceptance of the test results. A test report may be invalidated or rejected by the Department on the basis of irregularities observed on-site or noted during the test report review. The most common test invalidation criteria include, but are not limited to, the following:

1. Testing and/or Sampling Errors

   a. Sampling procedures that do not conform to test method requirements unless approved in advance by the Department.

   b. Isokinetic sampling rate out of acceptable range

c. Procedures or items of equipment that do not conform to the test method requirements

d. Samples collected during non-representative process operating conditions

e. Zero and upscale calibration values exceed the sampling system bias specification stated in an instrumental analyzer method

f. A measured gas concentration that exceeds the measurement range of the analyzer (i.e., the analyzer is pegged) at any time during a test run

g. Excessive post-test leak rate

2. Major Sample Loss or Alteration

a. Spillage of sample

b. Loss of filter integrity (holes or tears)

c. Events or procedures that cause sample loss

d. Sample contamination

3. Analysis Errors

a. Reagents, procedures, or analysis techniques that do not conform to the test method requirements

b. Improper formulas for calculating results

c. Missing pages in report

Date: 2/9/09

Approved by: Terry O'Clair

Terry L. O'Clair, P.E.
Director
Division of Air Quality

Attachments:
Appendix A
Appendix B

APPENDIX A

Test Plan Format for Emission Unit Testing In North Dakota

Emission Unit Test Plan

A. **General Information**:

Facility Name: _____

Mailing Address: _____

Location: _____

Type: _____ Permit to Operate No. _____

Name of Contact Person: _____

Mailing Address: _____

Telephone No.: _____ Email: (optional) _____

Emission Unit Name and Identification Number: _____

Startup Date (if emission unit is new): _____

Proposed Test Date: _____

B. **Testing Firm Information**:

Firm Name: _____

Mailing Address: _____

Name of Contact Person: _____

Title: _____ Telephone No.: _____

C. **Emission Test Information**:

List all pollutants to be sampled.

	Pollutant	EPA Reference Method	No. of Test Runs	No. of Sampling Points	Total Time per Test Run
1					
2					
3					
4					
5					

Include information on the sampling train, laboratory analysis, process operation, safety considerations, and samples of the data sheets that will be used.

D. **Stack or Emission Point Information**:

Dimensions at Testing Location: _____

Estimated Temperature: _____ Estimated Moisture Content: _____

Attach a sketch of the stack or duct showing port locations relative to upstream and downstream flow disturbances.

E. **Proposed Emission Unit Operation During Test:**

Operating Rate: _____ % of Capacity: _____

Name and Title of Person Responsible for Collecting Process and Pollution Control Equipment Data: _____

F. **Comments:**

_____

_____

_____

_____

_____

_____

_____

_____

_____

Submit the test plan to:

North Dakota Department of Health
Division of Air Quality
918 E. Divide Avenue, 2nd Floor
Bismarck, ND 58501-1947

Telephone: 701-328-5188
Fax: 701-328-5185

APPENDIX B

Emission Test Report Format

Emission Test Report Format

A. **Cover Page**:

Indicate the name and location of the facility, the specific emission unit(s) tested (including unit identification and/or serial number when applicable), the name and address of the testing firm (or agency), and the date of the test.

B. **Certification**:

Include a certification by the test team leader who is responsible for the test data, and a certification by the reviewer of the test report (normally the supervisor of the team leader) attesting to the authenticity and accuracy of the report.

C. **Table of Contents**:

Self explanatory

D. **Introduction**:

Pertinent background information is presented here, but is not limited to the following:

1. Name, address/location, and owner of the facility
2. Purpose of the test
3. Test date(s)
4. Pollutant(s) tested
5. Name and address of testing firm
6. Names of persons present during testing (facility, industry and Department)
7. Any other relevant background information

E. **Summary of Test Results**:

This section should include, but not be limited to the following items:

1. Emission results in the same units as the applicable emission limit(s) or standard
2. Allowable emissions
3. Summary of key parameters such as date/time of test runs, stack gas velocity and flow rate, stack temperature, moisture content, $CO/O_2/CO_2$ gas composition; and isokinetic variation, pollutant gas concentration, and particulate concentration when applicable.
4. Description of collected samples
5. Discussion of any errors or deviations in testing

F. **Emission Unit Operations During Testing:**

This section describes the emission unit and includes, at least, the following items:

1. General description of the emission unit, including associated air pollution control equipment
2. Process and control equipment flow diagram
3. Presentation of the operations and process data and a determination of whether these conditions were representative of those required for testing
4. Changes in operating conditions from those previously agreed upon by the facility and the Department

G. **Sampling and Analytical Procedures:**

A description of the sampling and analytical methods should be presented in this section. The information shall include, but not be limited to the following items:

1. Description of sampling location(s) and sampling points
2. Schematic drawings showing sampling location(s), major and minor flow disturbances, and stack or duct cross section(s) with dimensions indicated
3. Description of sampling equipment
4. Schematic drawings of sampling trains (may be included in an appendix)
5. Description of sampling procedures and run times, with a discussion of any deviations* from the standard test method(s), and a justification of the deviations
6. Description of the analytical procedures, with a discussion of any deviations* from the standard methods
7. Description of the methods employed for other types of sampling and analyses, such as fuel

* All deviations from the Reference Method procedures must be explained fully (i.e., failure to maintain required temperature in the sampling train, improper calibration gas, shorter run time, etc.). The explanation must include an analysis of how the deviation may have affected the test result(s).

H. **Quality Assurance:**

This section shall include, but not be limited to the following items:

1. Equipment calibration data sheets for dry gas meters, pitot tubes, probe nozzles and magnehelic gauges, etc.
2. Calibration gas certification data sheets, if applicable
3. Impinger solution blanks, if required
4. Acetone and water residue blanks, if required
5. Instrument linearity data
6. NO_x analyzer (NO_2 to NO) converter performance test
7. Instrument analyzer calibration error and response time results

8. Sampling system bias and drift results
9. Results of EPA Quality Assurance Audit samples, if applicable

I. **Laboratory Reports**:

Include the following if applicable:

1. Photocopies of original data sheets
2. Chain of custody data sheets
3. Analytical methods description
4. Laboratory QA/QC including impinger, acetone and water residue blanks
5. Laboratory statement of qualifications

J. **Methods and Calculations**:

This section shall include, but not be limited to the following items:

1. Equations used match those in the applicable test method
2. Complete set of step-by-step example calculations for at least one test run
3. Description of deviations from applicable calculations or test methods

K. **Appendices**:

Reports may include an appendix for any section listed above, or as appropriate for the following items:

1. A summary of all data used in the calculations
2. Copies of all raw field data sheets; sheets must be legible
3. Process/production data signed by a plant official if provided by the facility
4. Chain-of-custody procedures utilized and chain-of-custody forms
5. Any other information necessary to assist the Department in making a compliance determination

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MEMO TO : Permitting and Compliance Branch Staff, and Owners/Operators of Select Title V Facilities

FROM : Terry L. O'Clair, P.E.
Director
Division of Air Quality

RE : Continuous Emission Rate Monitoring Systems (CERMS) Certification and Relative Accuracy

DATE : May 18, 2011

The Department has utilized continuous emission monitoring systems (CEMS) for compliance determinations for many years. These systems measure emissions in terms of "lb/10^6 Btu" based on data from a gaseous monitor, such as NO_x or SO_2, plus a diluent (CO_2 or O_2) monitor. Unlike a CEMS, continuous emission rate monitoring systems (CERMS) consist of the total equipment required for determining and recording the pollutant mass emission rate in terms of mass per unit of time such as "lb/hr." The primary difference in the two systems is the CERMS also utilizes data produced from a continuous flow sensor or monitor.

The Department has reevaluated the methods used to date to certify and determine the relative accuracy (RA) of CERMS for parameters such as NO_x lb/hr and SO_2 lb/hr. Whereas the procedures in 40 CFR 60, Appendix B, Performance Specification 6 should be followed for a CERMS, due to permit requirements some of the monitors that comprise a CERMS have been subjected to procedures in Performance Specification 2 which applies only to CEMS.

Specification 2 must continue to be used for evaluating the acceptability of a CEMS for all 40 CFR 60, Subpart Db boilers subject to NO_x lb/10^6 Btu and SO_2 lb/10^6 Btu limits.

However, an evaluation of the acceptability of a CERMS, which includes a flow monitor, must be in accordance with the procedures in Specification 6. There is no RA limit for a flow monitor in Specification 6; the RA limit is for the total system and not for the individual monitors. Therefore, when the RA for a parameter such as NO_x lb/hr is determined and reported, it must be based on data provided jointly by the individual monitors (NO_x ppm, O_2% or CO_2% and flow monitor velocity, pressure and temperature, as applicable). In determining the RA of a CERMS, Specification 6 states "The RA of the CERMS shall be no greater than 20 percent of the mean value of the RM's test data in terms of the units of the emission standard, or 10 percent of the applicable standard, whichever is greater."

An example RA determination for a typical CERMS follows: Assume that the reference method (RM) data, the CERMS data, and the difference between the two for each run have been entered on a form such as shown in Figure 6-1 of Specification 6. Then assume that the average reference method value (RM_{avg}) value and the average CERMS value ($CERMS_{avg}$) are 4.909 lb/hr and 5.819 lb/hr respectively with the difference being 0.910 lb/hr. Also assume the applicable standard, or emission limit is 13.44 lb/hr.

Does the CERMS comply with the RA limit?

- 20% of RM_{avg} = 0.2 x 4.909 lb/hr = 0.9818 lb/hr
- 10% of emission limit = 0.1 x 13.44 lb/hr = 1.344 lb/hr,
- The greater of the two is 1.344 lb/hr which becomes the RA limit.
- The difference between the RM_{avg} and the $CERMS_{avg}$ = 0.910 lb/hr
- The CERMS complies with the RA limit of 1.344 lb/hr because $0.910 \leq 1.344$.

With the same example modified slightly, assume that the applicable standard or emission limit is 8.50 lb/hr. 10% of the emission limit is 0.850 lb/hr; therefore, the RA limit is 0.9818 lb/hr because it is the greater of the two ($0.9818 > 0.850$). The CERMS is compliant at 0.910 lb/hr.

From the date of this memo forward, facilities with boilers subject to 40 CFR 60, Subpart Db with a permit that requires continuous monitoring of a pollutant in mass per unit of time, the RA of a CERMS for NO_x lb/hr and/or SO_2 lb/hr is to be determined by following the procedures in 40 CFR 60, Appendix B, Performance Specification 6 unless otherwise specified.

The Department will eventually revise the appropriate permit condition(s) as necessary to read generally as follows: "The continuous emission monitoring systems (CEMS) and the continuous emission rate monitoring systems (CERMS) for nitrogen oxides and sulfur dioxide shall be used to determine compliance with the nitrogen oxides and sulfur dioxide emission limits applicable to the [ ] boiler(s). The CEMS and the CERMS for the boiler(s) shall be certified to comply with the applicable requirements of 40 CFR 60, Appendix B, Performance Specification 2 for a CEMS, and Performance Specification 6 for a CERMS. A relative accuracy test audit (RATA) shall be conducted annually on the nitrogen oxides and sulfur dioxide CEMS and CERMS in accordance with the applicable procedures in 40 CFR 60, Appendix B, Performance Specification 2 for a CEMS and Performance Specification 6 for a CERMS."

If there are any questions regarding the above procedures for a CERMS, please do not hesitate to contact Gary Kline or Benjamin Gress of my staff at 701-328-5188, or email gkline@nd.gov or bpgress@nd.gov.

TLO/GLK:saj

Continuous Emission Rate Monitoring System (CERMS)
Relative Accuracy Calculation
40 CFR 60, Appendix B

The Department published and distributed a memorandum dated May 18, 2011, to clarify for staff and owners/operators of select Title V facilities the method to be used when calculating the relative accuracy (RA) of a CERMS and its RA limit if required by a permit condition.

The provisions of the Department's memorandum was brought to the attention of a testing company in June of 2012 when their test report utilized Performance Specification 2 (PS 2) rather than PS 6 of Appendix B, 40 CFR 60 to determine the RA of a CERMS. The testing company subsequently contacted a representative of EPA and was told that the RA of the CERMS should be calculated in the same manner as in PS 2 for a continuous emission monitoring system (CEMS). It became apparent to the Department that there was disagreement on how to calculate RA for a CERMS.

This paper will discuss selected provisions of 40 CFR 60, Appendix B, PS 2 for NO_x and SO_2 CEMS, PS 3 for O_2 and CO_2 CEMS, and PS 6 for CERMS. An attempt will be made to identify the provisions of PS 3 and PS 6 that make reference to PS 2 which, if misapplied, result in contradictory procedures for calculating RA.

As written, it is apparent that PS 2 serves as a baseline document upon which other performance specifications such as PS 3 and PS 6 are structured. This approach is similar to Reference Method (RM) 7E for NO_x emissions testing where it serves as a baseline document for SO_2 emissions testing under RM 6C.

The following three paragraphs describe how RA **limits** are calculated for PS 2, PS 3 and PS 6.

A. Subsection 13.2 of PS 2 is quoted: "13.2 Relative Accuracy Performance Specification. The RA of the CEMS must be no greater than 20 percent when RM is used in the denominator of Eq. 2-6 (average emissions during test are greater than 50 percent of the emission standard) or 10 percent when the applicable emission standard is used in the denominator of Eq. 2-6 (average emissions during test are less than 50 percent of the emission standard)." Note: The RA limit of a CEMS is expressed as a percent (%). Also, it should be noted that NO_x and SO_2 emission limits for sources subject to 40 CFR 60, Subparts D, Da, Db, etc., are expressed in lb/MMBtu.

B. Section 13.2 of PS 3 for O_2 or CO_2 CEMS is quoted: "13.2 CEMS Relative Accuracy Performance Specification. The RA of the CEMS must be no greater than 1.0 percent O_2 or CO_2." Note: RA is the average difference between the RM and the CEMS for the nine (or more) data sets. The RA limit is expressed as a percent of O_2 or CO_2, not as a percent (%) as in PS 2.

C. Section 13.2 of PS 6 is quoted: "13.2 CERMS Relative Accuracy. The RA of the CERMS shall be no greater than 20 percent of the mean value of the RM's test data in terms of the units of the emission standard, or 10 percent of the applicable standard,

whichever is greater." Note: The RA limit of a CERMS is expressed in units of a standard such as lb/hr (mass per unit of time). It is concluded that since many State agencies also specify permit limits in lb/hr for some source units or emission points, a flow rate sensor, plus the normal gas and diluent analyzers of a CEMS, is needed to provide lb/hr data. With the addition of a flow rate sensor, the basic NO_x or SO_2 CEMS becomes a continuous emission rate monitoring system, or CERMS.

D. Summary of RA limits: PS 2 is %. PS 3 is percent O_2 or CO_2. PS 6 is lb/hr.

Definitions of RA in PS 2, PS 3 and PS 6 follow:

A. PS 2, Section 3.0 Definitions, Subsection 3.9 is quoted: "Relative Accuracy (RA) means the absolute mean difference between the gas concentration or emission rate determined by the CEMS and the value determined by the RM, plus the 2.5 percent error confidence coefficient of a series of tests, divided by the mean of the RM test or the applicable emission limit". Using the equations in Section 12.0 "Calculations and Data Analysis" of PS 2, RA is expressed in %.

B. PS 3, Section 3.0 Definitions is quoted: "Same as in Section 3.0 of PS 2."

C. PS 6, Section 3.0 Definitions is quoted in part: "The definitions are the same as in Section 3.0 of PS 2 . . . ." This section also defines a CERMS and a flow rate sensor.

If the RA for a O_2 or CO_2 CEMS is the average difference between the RM and the CEMS output data ($RA = RM_{avg} - CEMS_{avg}$) expressed as a percent of O_2 or CO_2, then the PS 2 equations Eq. 2-4 for standard deviation (S_d), Eq. 2-5 for confidence coefficient (CC), and also Eq. 2-6 for relative accuracy (RA) cannot apply to PS 3. It follows that if the RA of the CERMS is also the average difference between the RM and the CERMS output data ($RA = RM_{avg} - CERMS_{avg}$) expressed in mass per unit of time, typically lb/hr, then Eq. 2-4, Eq. 2-5 and Eq. 2-6 of PS 2 cannot apply to PS 6.

The tendency by some agencies/testing companies to calculate the RA of a CERMS using the procedures in PS 2 is the result of misleading language in Section 12.0 of PS 6 where it states "12.0 Calculations and Data Analysis" "Same as Section 12.0 of PS 2." The above paragraph supports the use of PS 2 Eq. 2-1, 2-2 and 2-3 to correct for moisture and diluent basis if necessary, and to calculate the arithmetic mean for data analysis in PS 3 and PS 6. However, the subsequent equations of PS 2 (Eq. 2-4, 2-5 and 2-6) are not applicable because RA and RA limits for PS 3 and PS 6 are expressed in terms different than that of PS 2.

Conclusion: The method(s) in PS 6 for determining RA and for calculating the RA limit of a CERMS, in terms of mass per unit of time (lb/hr), is different than that of PS 2 where RA is expressed in %. The Department memo dated May 18, 2011 continues to be the Department's policy for RA calculations pertaining to a CERMS.

Related Miscellaneous Items:

A. Whereas the PS 6 certification requirement of a CERMS includes a Calibration Drift test for each analyzer (gas, diluent and velocity/flow) that comprises the system, there is no RA specification for the flow-rate sensor. The RA specification is for the entire system and not for individual analyzers. Therefore, it serves no purpose to calculate the RA of a flow rate sensor using the procedures referenced in PS 2.

B. Some testing companies use PS 2 procedures to calculate RA of the O_2 or CO_2 diluent analyzer as part of a NO_x and/or a SO_2 CEMS. The RA limit in % applies to the entire CEMS in units of the standard, i.e., lb/MMBtu, and not to the individual gas and diluent analyzers that comprise the CEMS. If agencies and/or testing firms insist on calculating the RA of a diluent analyzer, they must be **assuming** that the diluent analyzer has a RA limit specified in PS 2. The question then arises as to how to interpret Subsection 13.2 "Relative Accuracy Performance Specification" of PS 2. It would be necessary to substitute "The RA of the diluent analyzer" in lieu of "The RA of the CEMS." Also, it would be necessary to figure out how to interpret the part of Subsection 13.2 that says "or 10 percent when the applicable emission standard is used in the denominator of Eq. 2-6." In PS 2 there is no applicable emission standard for the diluent analyzer so a RA calculation for that component of the CEMS is meaningless. In a similar manner, calculating RA of the NO_x or SO_2 analyzer based on "ppm" data is not mandated or needed unless the permit to operate specifies a ppm RA limit

C. It is interesting to note that all States do not agree on matters pertaining to excessive audit criteria for a cylinder gas audit (CGA) required by Appendix F of 40 CFR 60. Specifically, in reviewing a CGA report involving a CO_2 analyzer, the criteria for excessive audit inaccuracy of "±15 percent of the average audit value or ±5 ppm, whichever is greater" specified in 5.2.3 of Appendix F was not used. The consulting firm representative, when contacted, stated that another State they represent believed the criteria in Appendix F was too lenient when applied to a CO_2 or O_2 analyzer. Instead they preferred to use the criteria found in Subsection 13.1 of PS 3 of 40 CFR 60, Appendix B that pertains to "Calibration Drift Performance Specification;" that criteria limits drift to no more than 0.5 percent O_2 or CO_2.

Presented by: Gary L. Kline
Division of Air Quality
ND Department of Health
September 16, 2013