

**North Dakota Department of Environmental Quality**  
**Division of Air Quality**  
**Use of Portable Analyzer for Title V Semi-Annual Testing**  
**Standard Operating Procedure**

A. **Date:**

December 11, 2019

B. **General:**

The North Dakota Department of Environmental Quality, Division of Air Quality (Department) approves the use of portable analyzers to measure NO<sub>x</sub> and CO emissions with quality assurance procedures equivalent to Environmental Protection Agency (EPA) Test Methods in 40 CFR 60, Appendix A or the following minimum Standard Operating Procedure (SOP), which is strongly based on EPA's Conditional Test Method (CTM) - 030. The purpose of the SOP is not to replace the Reference Methods of 40 CFR 60, Appendix A, but to facilitate the measurement of emissions from sources that require periodic emissions testing. The SOP is limited to measurements of NO<sub>x</sub> (NO and NO<sub>2</sub>) and CO.

The tester may submit other quality assurance procedures/protocol for Department approval. The protocol must comply with the minimum requirements of this SOP and must address all pertinent information regarding the analyzer as well as all requirements listed in the following sections to be considered for approval. It is the Department's discretion to determine if approval is warranted.

C. **Measurement System Performance Specifications:**

I. **Pre-Test Calibration Error Check**

- i. *Calibration Gas Concentration Verification* – The analyzer shall be calibrated prior to the emission test with calibration gases certified to  $\pm 2\%$  accuracy.
- ii. *Two calibration gases* (zero and span) for O<sub>2</sub>, CO, NO and NO<sub>2</sub> shall be used.
  1. Zero Gas – concentration of the zero gas shall be less than 0.25 percent of the span gas. Purified ambient air may be used as the zero gas.
  2. Span Gas – concentration of the span calibration gas shall be no higher than 125% of the expected concentration nor less than 90% of the expected concentration. The span gas is equal to the calibration span.
- iii. *Analyzer calibration error* shall be no more than  $\pm 5\%$  of the calibration span value for the span NO, NO<sub>2</sub> and CO calibration gases and no more than  $\pm 0.5\%$  of the calibration span value for the span O<sub>2</sub> calibration gas. The analyzer

calibration error shall be no more than  $\pm 3\%$  of the calibration span value for the zero NO, NO<sub>2</sub> and CO calibration gases and no more than  $\pm 0.3\%$  of the calibration span value for the zero O<sub>2</sub> calibration gas. The calibration error shall be calculated as follows:

$$\% \text{ Difference} = \frac{\text{Analyzer Response} - \text{Gas Concentration}}{\text{Calibration Span}} \times 100$$

## II. Linearity Check

- i. The absolute value of the difference between the calibration gas value and the analyzer response shall be no greater than 2.5% of the calibration span for the NO, CO and O<sub>2</sub> zero, mid-level, and span gases. The absolute value of the difference between the calibration gas value and the analyzer response shall be no greater than 3.0% of the calibration span for the NO<sub>2</sub> zero, mid-level and span gases. A linearity check shall be repeated before each five days of analyzer operation.
- ii. *Three calibration gases* (zero, mid-level, and span) for O<sub>2</sub>, CO, NO and NO<sub>2</sub> shall be used.
  1. Zero Gas – concentration of the zero gas shall be less than 0.25 percent of the span gas. Purified ambient air may be used as the zero gas.
  2. Mid-Level Gas – concentration that is 40% to 60% of the span calibration gas.
  3. Span Gas – concentration of the span calibration gas shall be no higher than 125% of the expected concentration nor less than 90% of the expected concentration. The span gas is equal to the calibration span.

## III. Cross Interference Check

- i. While performing the pre-test calibration, check for and record any response noted on one sensor while calibrating another cell. Interference shall be calculated using the following equation:

$$\% \text{ Interference} = \frac{\text{Analyzer Response}}{\text{Gas Concentration}} \times 100$$

Interference shall be no greater than  $\pm 5\%$  of the average stack concentration for each test run.

**IV. Stability Check Response**

- i. The analyzer response to CO, NO and NO<sub>2</sub> span gas values shall not vary more than 2.0% of the span gas value over a 30-minute period or more than 1.0% of the span gas value over a 15-minute period. A stability check response shall be repeated before each five days of analyzer operation.

**V. NO Cell Temperature Monitoring**

- i. A thermocouple, thermistor, or other device must be used to monitor the temperature of the NO electrochemical cell. NO cell temperature reporting is not required when temperature monitoring and the ability to control for temperature fluctuations is incorporated in the portable analyzer *if* the Department is provided proper documentation illustrating that the portable analyzer can control temperature fluctuations *and* Department approval is provided. If Department approval is *not* provided, NO cell temperature reporting is required, which consists of recording the initial NO cell temperature during the pre-test calibration error check and recording the temperature at least once every five minutes during sample collection. If the NO cell temperature is 85°F or greater during sample collection and has changed more than 5°F since the pretest calibration, sampling must be stopped immediately, and a post-test calibration error check must be conducted. The analyzer must then be re-zeroed, and another pretest calibration error check must be conducted before continuing.

**VI. Emissions Testing**

- i. Allow the analyzer to purge the calibration gases prior to beginning the emissions test.
- ii. A test shall consist of three runs, with each run at least 20 minutes in length.
- iii. Record the readings for CO, NO and NO<sub>2</sub> at 2-minute intervals during each 20-minute run.

**VII. Post-Test Calibration**

- i. After a maximum of three valid 20-minute runs, conduct a post-test calibration as follows for the O<sub>2</sub>, CO, NO and NO<sub>2</sub> calibration gases:
  1. Allow the analyzer to purge the gas sample until a stable zero reading is observed. Record the zero reading.
  2. Introduce the span gas to the analyzer and allow it to reach a stable reading. Record the analyzer reading.

3. Introduce the zero gas to the analyzer and allow it to reach a stable reading. Record the analyzer reading.
- ii. Calculate the difference to the pre-test calibration value. The emissions test runs are invalid and must be repeated if any of the following are true:
1. Span Calibration Error: The difference is greater than  $\pm 5\%$  of the calibration span value for the NO, NO<sub>2</sub> and CO calibration gases.
  2. Span Calibration Error: The difference is greater than  $\pm 0.5\%$  of the calibration span value for the O<sub>2</sub> calibration gas.
  3. Zero Calibration Error: The difference is greater than  $\pm 3\%$  of the calibration span value for the NO, NO<sub>2</sub> and CO calibration gases.
  4. Zero Calibration Error: The difference is greater than  $\pm 0.3\%$  of the calibration span value for O<sub>2</sub> calibration gas.

The calibration error shall be calculated as follows:

$$\% \text{ Difference} = \frac{(\text{Post} - \text{Test Reading}) - (\text{Pre} - \text{Test Reading})}{\text{Pre} - \text{Test Reading}} \times 100$$

**VIII. Stack Gas Volumetric Flow and Moisture Content**

- i. The stack gas volumetric flow and moisture content may be determined using 40 CFR 60, Appendix A, Methods 1 through 4 or by knowledge of fuel gas composition and combustion stoichiometry. Combustion stoichiometry may be used to determine stack flow only if quality assurance procedures are submitted to the Department and approved prior to use in the field.

The Department will not accept any portable analyzer test unless all the above conditions are met, or a separate testing protocol has been approved in advance by the Department.

The Department reserves the right to withdraw or modify this SOP without advance notice.

Approved by:



James L. Semerad  
 Director  
 Division of Air Quality

Date: 12/11/19

### Emission Test Worksheet

Test Date(s) \_\_\_\_\_ Permit No. \_\_\_\_\_  
 Tested By \_\_\_\_\_  
 Source \_\_\_\_\_  
 Company \_\_\_\_\_  
 Location \_\_\_\_\_  
 Engine Serial No. \_\_\_\_\_ Emission Unit No. \_\_\_\_\_  
 Analyzer Model # \_\_\_\_\_ Analyzer Serial # \_\_\_\_\_

#### NO Calibration Error and Linearity Check

	NO Calibration Gas	Calibration Span (ppm)	Gas Concentration (ppm)	Analyzer Response (ppm)	Difference
Pre-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Post-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Linearity Check	Zero				% <sup>C</sup>
	Mid-Level				% <sup>C</sup>
	Span				% <sup>C</sup>

- A May not be greater than  $\pm 3.0\%$  of the calibration span
- B May not be greater than  $\pm 5.0\%$  of the calibration span
- C May not be greater than  $\pm 2.5\%$  of the calibration span

#### NO<sub>2</sub> Calibration Error and Linearity Check

	NO <sub>2</sub> Calibration Gas	Calibration Span (ppm)	Gas Concentration (ppm)	Analyzer Response (ppm)	Difference
Pre-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Post-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Linearity Check	Zero				% <sup>C</sup>
	Mid-Level				% <sup>C</sup>
	Span				% <sup>C</sup>

- A May not be greater than  $\pm 3.0\%$  of the calibration span
- B May not be greater than  $\pm 5.0\%$  of the calibration span
- C May not be greater than  $\pm 3.0\%$  of the calibration span

**CO Calibration Error and Linearity Check**

	NO <sub>2</sub> Calibration Gas	Calibration Span (ppm)	Gas Concentration (ppm)	Analyzer Response (ppm)	Difference
Pre-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Post-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Linearity Check	Zero				% <sup>C</sup>
	Mid-Level				% <sup>C</sup>
	Span				% <sup>C</sup>

<sup>A</sup> May not be greater than ±3% of the calibration span

<sup>B</sup> May not be greater than ±5% of the calibration span

<sup>C</sup> May not be greater than ±2.5% of the calibration span

**O<sub>2</sub> Calibration Error and Linearity Check**

	NO <sub>2</sub> Calibration Gas	Calibration Span (%)	Gas Concentration (%)	Analyzer Response (%)	Difference
Pre-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Post-Test Calibration Error	Zero				% <sup>A</sup>
	Span				% <sup>B</sup>
Linearity Check	Zero				% <sup>C</sup>
	Mid-Level				% <sup>C</sup>
	Span				% <sup>C</sup>

<sup>A</sup> May not be greater than ±0.3% of the calibration span

<sup>B</sup> May not be greater than ±0.5% of the calibration span

<sup>C</sup> May not be greater than ±2.5% of the calibration span

**Cross Interference Check**

Gas (Span)	Calibration Span	CO Response	NO Response	NO <sub>2</sub> Response	% Interference *	
CO		--				
NO			--			
NO <sub>2</sub>				--		

\* May not exceed 5%.

**Stability Check**

Elapsed Time (min)	Analyzer Response (ppm NO <sub>2</sub> )	Analyzer Response (ppm NO)	Analyzer Response (ppm CO)	Elapsed Time (min)	Analyzer Response (ppm NO <sub>2</sub> )	Analyzer Response (ppm NO)	Analyzer Response (ppm CO)
1				19			
2				20			
3				21			
4				22			
5				23			
6				24			
7				25			
8				26			
9				27			
10				28			
11				29			
12				30			
13				31			
14				32			
15				33			
16				34			
17				35			
18				36			

**Time to Stability (minutes)**

NO<sub>2</sub>: \_\_\_\_\_

NO: \_\_\_\_\_

CO: \_\_\_\_\_

Test Time: \_\_\_\_\_

Gas (Span)	Calibration Span (ppm)	Maximum Value	Minimum Value	Difference
CO				% *
NO				% *
NO <sub>2</sub>				% *

\* May not exceed 2.0% of span gas value over a 30-minute period or 1.0% over a 15-minute period.

**Operating Information**

	Engine Fuel Consumption (MMBtu/hr)	Fuel Gas Flow (scf/hr)	Engine Specific Fuel Consumption (Btu/bhp-hr)	Fuel Heat Content (Btu/scf)
Run 1				
Run 2				
Run 3				

**Emission Test Raw Data**

Run	Time	NO Cell Temperature (°F)	CO (ppm)	NO (ppm)	NO <sub>2</sub> (ppm)	NO <sub>x</sub> (ppm) *
1	Pre-test calibration		--	--	--	--
	0:02	--				
	0:04	--				
	0:05		--	--	--	--
	0:06	--				
	0:08	--				
	0:10					
	0:12	--				
	0:14	--				
	0:15		--	--	--	--
	0:16	--				
	0:18	--				
	0:20					
	average					
2	Pre-test calibration		--	--	--	--
	0:02	--				
	0:04	--				
	0:05		--	--	--	--
	0:06	--				
	0:08	--				
	0:10					
	0:12	--				
	0:14	--				
	0:15		--	--	--	--
	0:16	--				
	0:18	--				
	0:20					
	average					
3	Pre-test calibration		--	--	--	--
	0:02	--				
	0:04	--				
	0:05		--	--	--	--
	0:06	--				
	0:08	--				
	0:10					
	0:12	--				
	0:14	--				
	0:15		--	--	--	--
	0:16	--				
	0:18	--				
	0:20					
	average					

\* NO<sub>x</sub> (ppm) = NO (ppm) + NO<sub>2</sub> (ppm)