NOX Periodic Measurement Protocol for Consent Agreement and Final Order, Docket No. CAA-07-2019-0261

September 2019

1. APPLICABILITY AND PRINCIPLE

1.1 Applicability. This NOx monitoring protocol is applicable to the periodic nitrogen oxides (NO and NOx) monitoring at CertainTeed's Kansas City Insulation plant described in paragraph 51 of the Consent Agreement and Final Order (CAFO), Docket No. CAA-07-2019-0261, In the Matter of: CertainTeed Corporation, 103 Funston Road, Kansas City, Kansas, dated September 2019.

1.2 Principle. A gas sample is extracted from a stack and is conveyed to a portable Electrochemical Cell (EC) analyzer for determination of NO, NOx. Analyzer performance specifications and test procedures are provided in sections 4, 6, and 7 to ensure reliable measurements. A Testo 330 Flue gas analyzer or equivalent ("Measuring Device") is used to measure the emission.

2. RANGE AND ACCURACY

2.1 Analytical Range. The measuring ranges and resolution of a typical Measuring Device for flue gas analysis based on information from a manufacturer is in the table below:

Parameter	Measuring range	Resolution
O_2	0...21 Vol.%	0.1 vol.%
CO	0...4000 ppm	1 ppm
CO, H_2-comp.[1]	0...8000 ppm	1 ppm
COlow	0...500 ppm	0.1ppm
AmbCO through flue gas probe	0...2000 ppm	1 ppm
AmbCO with probe 0632 3331	0...500 ppm	1 ppm
NO	0...3000 ppm	1 ppm
Draught	-9.99...40 hPa	0.01 hPa
ΔP	0...300 hPa	0.1 hPa
Temperature	-40...1200 °C	0.1°C (-40.0...999.9 °C) 1°C (rest of range)
Efficiency net	0...120 %	0.1 %
Flue gas loss	0...99.9 %	0.1 %
AmbCO2 with probe 0632 1240	0...1 vol. 0...10000 ppm	-
Gas leak testing with probe 0632 3330	0...10000 ppm CH4 / C3H8	-

2.2 Accuracy and response time (based on information from a manufacturer)

Parameter	Accuracy	Response time
O_2	±0.2 vol.%	< 20s (t90)
CO	±20 ppm (0...400 ppm) ±5% of mv (401...1000 ppm) ±10% of mv (1001...4000 ppm)	< 60s (t90)
CO, H_2-comp.	±10 ppm or ±10 % of mv[2] (0...200 ppm) ±20 ppm or ±5 % of mv[2] (201...2000 ppm) ±10% of mv (2001...8000 ppm)	< 60s (t90)
COlow	±2 ppm (0...39.9 ppm) ±5 % of mv (rest of range)	< 40s (t90)
AmbCO through flue gas probe	±10 ppm (0...100 ppm) ±10 % of mv (101....2000 ppm)	< 35s (t90)
AmbCO with 0632 3331	±5 ppm (0...100 ppm)[3] ±5 % of mv (>101 ppm)	approx. 35s (t90)
NO	±5 ppm (0...100 ppm) ±5 % of mv (101....2000 ppm) ±10 % of mv (2001...3000 ppm)	< 30s (t90)
Draught[4]	±0.02 ppm or ±5% of mv[2] (-0.50...0.60 hPa) ± 0.03 hPa (0.61...3.00 hPa) ±1.5 % of mv (3.01...40.00 hPa)	-
ΔP	± 0.5 hPa (0.0...50.0 hPa) ±1 % of mv (50.1...100.0 hPa) ±1.5 % of mv (rest of range)	-

Parameter	Accuracy	Response time
Temperature	± 0.5 °C (0.0...100.0 °C) ±0.5 % of mv (rest of range)	probe dependent
Efficiency	-	-
Flue gas loss	-	-
AmbCO2, through 0632 1240	±50 ppm + 2 % of mv (0...5000 ppm) ±100 ppm + 3 % of mv (5001...10000 ppm)	approx. 35s (t90)
Gas leak testing with 0632 3330	-	< 2s (t90)

3. DEFINITIONS

3.1 Measurement Cycle. The measurement cycle includes the five following steps:

1) Bump test (auto calibration of the gas flue analyzer);
2) Record time to start measurement in stack;

3) Wait 3 minutes to stabilize the Measuring Device. Turn on recording by selecting the right program in the Measuring Device (program with 5 minutes recording);
4) Run measurement for 5 minutes; and
5) Purge Measuring Device gas flue analyzer for 2 minutes once measurement is completed.

4. MEASUREMENT SYSTEM PERFORMANCE SPECIFICATIONS

4.1 Bump Test with Measuring Device. When the start button is pressed, the start screen is displayed for 5 seconds then the pressure sensors are set to zero. If there is a device error, an "error diagnosis" is displayed. If everything is within specification the menu "measurements" is displayed. When the instrument is switched on the measurement, menu is opened and the gas sensors are zeroed. The Measuring Device must be in the open air during the zeroing phase.

5. APPARATUS AND REAGENTS

5.1 Measurement System. Use any measurement system that meets the performance and design specifications in Sections 4 and 5 of this method. The sampling system should maintain the gas sample at conditions that will prevent condensation in the lines or when it contacts the EC cells. A picture of the measurement system is shown in Figures 1A and 1B. The essential components of the measuring device flue gas analyzer are described below.

5.1.1 Sample Probe. Glass, stainless steel or other non-reactive material of sufficient length to traverse the sample points. The sample probe shall be designed to prevent condensation. See Figure 2.

5.1.2 Sample Line. Non-reactive tubing designed to transport the effluent from the sample probe to the moisture removal system. The sample line shall be designed to prevent condensation.

5.1.3 Sample Transport Lines. Non-reactive tubing to transport the sample from the moisture removal system to the electrochemical cell.

5.1.4 Moisture Removal System. A condensate container is in the back of the device. The fill level of the condensate trap can be read from the markings on the condensate trap. A warning message (red flashing light) is displayed if the fill level in the condensate trap reaches 90 %. See figure 3.

5.1.5 Particulate Filter. Filters before the inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the components. See figure 4.

5.1.6 Sample Pump. A leak-free pump that will provide the sample gas to the system at a flow rate sufficient to minimize the response time of the measurement system. If upstream of the EC cells, the pump shall be constructed of any material that is non-reactive to the gas being sampled. When the device is measuring a gas flow, a vibration feeling can be fell when touching the equipment.

5.1.7 Gas Analyzer. A device containing EC cells to determine the NO, NO_2, concentrations in the sample gas stream and, if necessary, to correct for interference effects. The analyzer shall meet the applicable performance specifications of Section 4 and 5 of this method.

5.1.8 Data Recorder. The data recorded and saved can then be printed via the Bluetooth printer

5.1.9 EC Cell Temperature Indicator. The analyzer should be equipped with a temperature measurement device (e.g. thermocouple, thermistor or equivalent) to monitor the EC cell temperature. The temperature may be monitored at the surface, within the cell, or in close proximity to the cells such that it indicates the operating temperature of the cells.

6. MEASUREMENT SYSTEM PERFORMANCE CHECK PROCEDURES

The following procedure defines the process to follow in order to verify analyzer performance and accuracy during the monitoring event measurement cycles.

6.1 Calibration Gas Concentration Verification. For the span gases, use certified calibration gases. For O2 calibration and CO and NOx zero gas, fresh air, free from ambient CO and NOx shall be permitted. Alternative certification techniques may be used if they are approved in writing by the applicable regulatory agency.

6.2 Pre-Monitoring Event Verification

6.2.1 Zero Calibration Check Procedure. When the Measurement Device is switched on the measurement menu is opened and the gas sensors are zeroed. The flue gas probe must be in the open air during the zeroing phase.

6.2.2 Pre-Monitoring Event Prior to conducting measurements for the day a known NOx concentration shall be used to evaluate the meter response. The meter response should be within ±10% of the known NOx concentration. The meter response will be documented in a log.
6.2.3 Post-Monitoring Event After conducting measurements for the day a known NOx concentration shall be used to evaluate the meter response. The meter response should be within ±10% of the known NOx concentration. The meter response will be documented in a log. If the post-test verification calibration checks do not meet the specifications, all test data for that component, based upon that test day calibration are null and void and re-calibration and re-testing is required. Make no changes to the sampling system or analyzer calibration until all of the post-test verification checks have been recorded.

7. NOx MONITORING PROCEDURE
7.1 Selection of Sampling Site and Sampling Points. The sampling site is located at the test port in the stack of the furnace. Sample is taken with the probe of flue gas analyzer inserted in one of the test ports.
7.2 Sample Collection. The measurement should be completed following the five following steps:
1) Bump test (auto calibration of the gas flue analyzer);
2) Record time to start measurement in stack;
3) Wait 3 minutes to stabilize Measuring Device. Turn on recording by selecting the right program in the measuring device (program with 5 minutes recording);
4) Run measurement for 5 minutes; and
5) Purge gas flue analyzer for 2 minutes once measurement is completed.

7.3 Data Recording. The average, minimum and maximum data of the measurement event will be recorded.

7.4 EC Cell Temperature and Flow Monitoring. For each measurement cycle, the average EC Cell temperature measurement is recorded by the gas flow analyzer.

7.5 Purge of the cells. After the measurement the cells have to be purged for 2 minutes in fresh air. When switching off the Measurement Device a pump starts and the sensors are rinsed until the switch-off thresholds (O_2>20%, other measurement parameters < 50 ppm) are reached. The maximum rinsing period is 3 minutes. Then the Measurement Device switches off.

7.6 Weather and Safety Exceptions to NOx monitoring described in paragraph 51 of the CAFO. If one or more of the following weather conditions are present during a scheduled monitoring day, then NOx monitoring shall not be conducted on that day and shall be rescheduled for a day when the conditions have abated and the NOx monitoring can be safely completed. Weather conditions shall be verified through NOAA data.

- Visible lightening
- Heat Index above 105°F
- Snow, accumulating snow & ice on stack testing platform.
- Cold, below +20°F or a wind-chill that is also below +20°F
- High wind above 30 miles/hour

With regard to the weekly NOx monitoring requirement at paragraph 51.b of the CAFO, at least one monitoring event will be completed during each calendar week. In the event adverse weather conditions persist for an extended period of time such that the completion of a monitoring event is not feasible during a calendar week, a monitoring event will be added to subsequent week such that 52 events are completed in the calendar year.

8. Monitoring Results
The monitoring results will be recorded as follows:

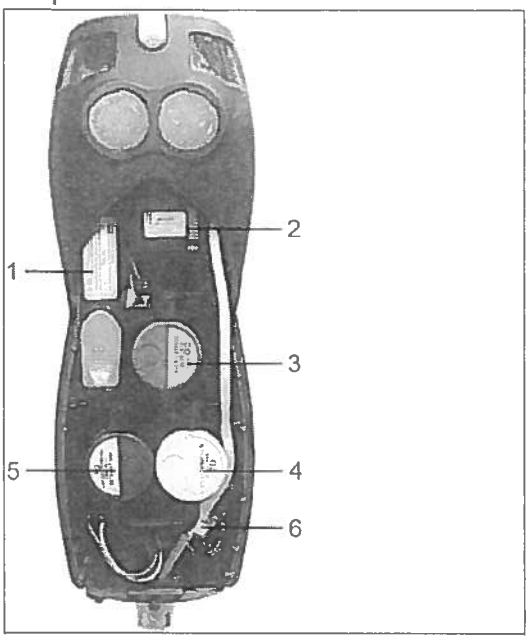
- Record the data of the 5 minutes monitoring event, an average will be calculated;
- Use the flow rate of the most recent stack test; and
- Enter data into a spreadsheet and write additional comments if needed.

FIGURES

Figure 1A – An Example Testo 330 flue gas analyzer

Figure 1B – An Example of the Testo 330 flue gas analyzer Components

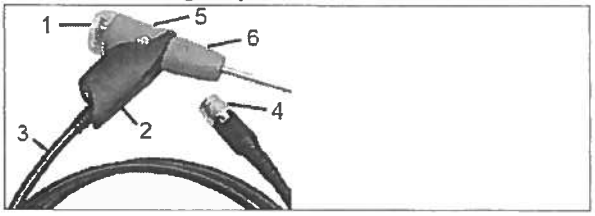
Components



1 Rechargeable battery
2 Measuring gas pump
3 Slot for CO-sensor or COlow-sensor
4 Slot O2-sensor
5 Slot NO-sensor
6 Additional filter

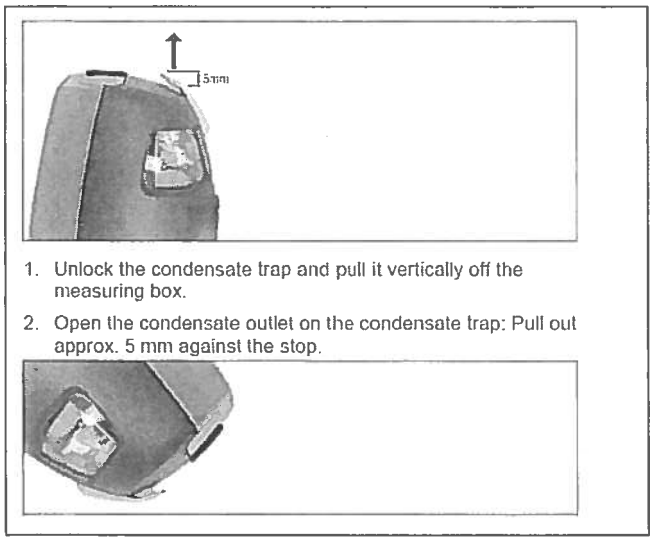
Figure 2 – An Example Gas probe

Modular flue gas probe



1 Removable filter chamber with window and particle filter
2 Probe handle
3 Connecting cable
4 Connector plug for measuring instrument
5 Probe module lock release
6 Probe module

Figure 3 – An Example Condensate Container



1. Unlock the condensate trap and pull it vertically off the measuring box.
2. Open the condensate outlet on the condensate trap: Pull out approx. 5 mm against the stop.

Figure 4 – An example Particle Filter of the probe