Source Test Procedure **ST-13A**

# OXIDES OF NITROGEN, CONTINUOUS SAMPLING

**REF: Regulations 9-3-301, 9-3-302, 10-1-301**

## 1. APPLICABILITY

1.1 This method is used to quantify emissions of oxides of nitrogen. It determines compliance with Regulations 9-3-301, 9-3-302 and 10-1-301.

## 2. PRINCIPLE

2.1 A gas sample is extracted continuously from the sampling point and conditioned to remove water and particulate material. Nitric oxide (NO) emissions are determined by passing a small portion of the sample through a chemiluminescent analyzer. The chemiluminescent process is based on the light given off when nitric oxide and ozone react. Nitrogen dioxide ($NO_2$) concentrations are determined by passing the sample through a catalyst which reduces the $NO_2$ to NO. The total oxides of nitrogen concentration ($NO_2$ + NO) is then determined by chemiluminescence.

## 3. RANGE AND SENSITIVITY

3.1 The minimum and maximum measurable concentrations of $NO_x$ depends on the specific chemiluminescent analyzer.

3.2 The minimum sensitivity of the analyzer shall be +/- 2% of full scale.

## 4. INTERFERENCES

4.1 If the molybdenum catalyst is used, compounds containing nitrogen (other than ammonia) may cause interference.

## 5. APPARATUS

5.1 Oxides of nitrogen analyzer. Use a Thermo Electron Corporati on Model 10A analyzer or its equivalent.

5.2 Chart Recorder. The recorder monitors and records the continuous output from the analyzer.

5.3 Sample conditioning, zero air, and span gas system. The assembly of this system is shown in Figure 13A-1. The sample conditioning system provides a dry, particulate free gas flow to the instrument. The zero air system provides clean dry atmospheric air for instrument calibration. The span gas system provides a known concentration of NO for use in calibrating the analyzer. Except as specified, all materials which come in contact with either the sample or span gases must be constructed of Teflon or stainless steel.

5.4 Sample Probe. Use a borosilicate glass tube of sufficient length to traverse the stack being tested. If the stack temperature exceeds 425 $^{o}$C (800 $^{o}$F), use a quartz probe. Other probes are acceptable subject to approval by the Source Test Section.

5.5 Condensers. Use modified Greenberg-Smith impingers with the impaction plates removed and the inlet tube shortened to a length of 10 cm (4 inches), or equivalent.

5.6 Cooling System. Immerse the impingers in an ice bath during the test.

5.7 Particulate Filter. Use a Balston type 95 holder with a grade B filter, or equivalent, in the sample system.

5.8 Pumps. Use leak-free, Teflon-lined, diaphragm pumps in the sample and zero air systems. The pumps must have a capacity of at least 28 liters/min (1.0 CFM).

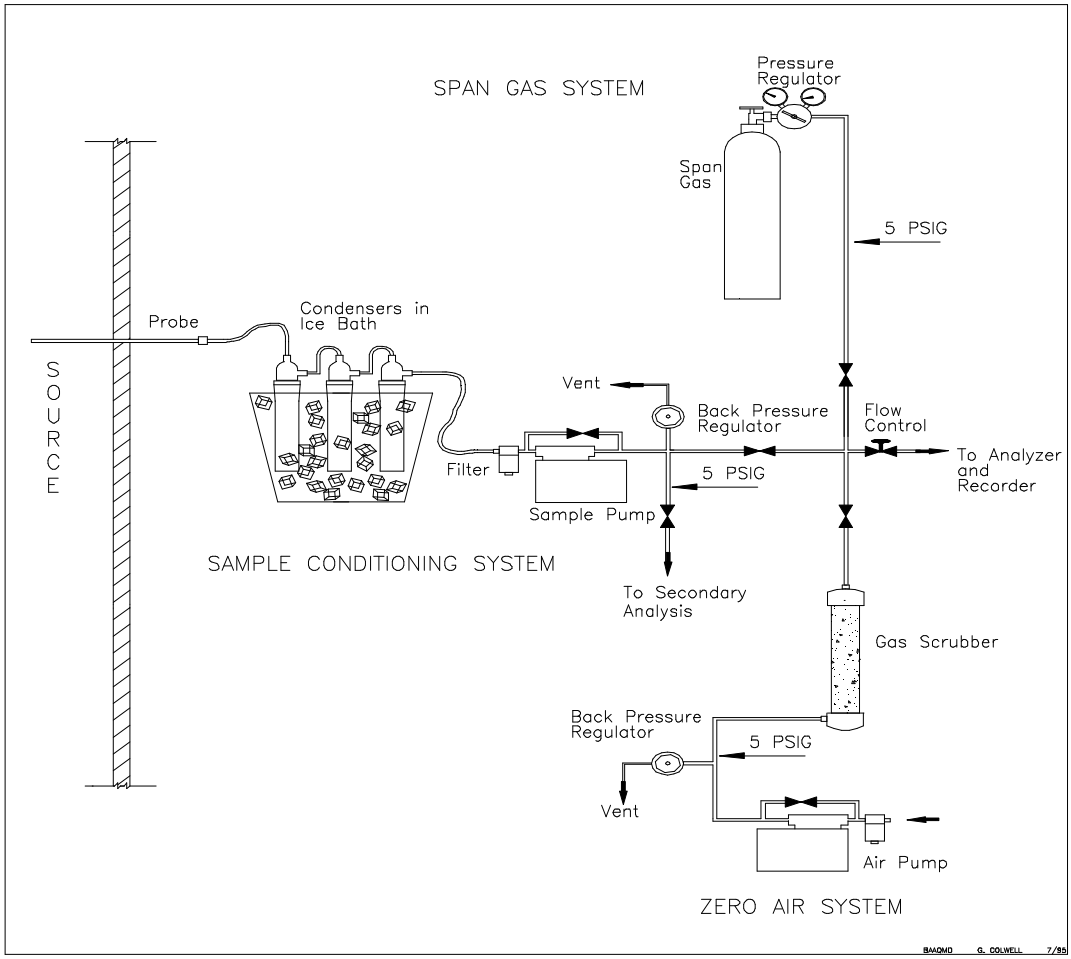
5.9 Back-pressure Regulator. Use a back-pressure regulator to maintain the sample and zero gas sample pressures to the instrument at five psig.

5.10 Gas Scrubber. Use a bed of silica gel, Ascarite (or soda-lime), and charcoal to remove moisture, carbon dioxide, and hydrocarbons from the zero air system.

5.11 Span Gas. Use a high-pressure cylinder containing a known concentration of NO in nitrogen. The span gas concentration must be in the same range as the source being tested.

**Figure 13A-1**

**Sample Conditioning, Zero Air, and Span-Gas Systems**



## 6. PRE-TEST PROCEDURES

6.1 Warm-up the instrument according to manufacturer's instructions.

6.2 Assemble the sampling system as shown in Figure 13A-1.

6.3 Leak-test the sampling system by starting the pump, plugging the probe, and determining that the pressure to the analyzer falls to zero. Other leak-tests are acceptable subject to the approval of the Source Test Section.

6.4 Introduce zero air, into the analyzer and zero the instrument according to manufacturer's instructions.

6.5 Introduce span gas into the analyzer and cali brate the instrument according to manufacturer's instructions.

6.6 Conduct a preliminary concentration traverse (according to ST-18) to determine if stratification of the stack gases exists. If the $NO_X$ concentration at any point differs from the average concentration by more than 10%, traverse the stack during the test. If not, sample at any single point.

6.7 Set-up the chart recorder according to manufacturer's instructions.

## 7. SAMPLING

7.1 Sample at continuous operations for a period of thirty minut es for each test run. Sample at batch operations for thirty minutes or 90% of the batch process time, whichever is less.

7.2 Introduce sample gas into the analyzer at the same flow rate used to calibrate the analyzer.

7.3 Maintain ice in the cooling system throughout the test.

7.4 Calibrate the analyzer before and after each test run. Record each step of the process clearly on the chart recording.

7.5 Conduct three test runs.

## 8. AUXILIARY TESTS

8.1 Oxygen concentration. Determine the oxygen concentr ation simultaneously with each $NO_X$ run in accordance with ST-14.

## 9. CALCULATIONS

9.1 Determine the time-averaged concentration of NO on a dry basis for each run form the chart recording.

9.2 Concentration of nitrogen oxides corrected to 3% oxygen.

$$C_{NO,3\%} = C_{NOx}\frac{17.95}{20.95 - C_{O2}}$$

Where:

$C_{NO,3\%}$ = Total concentration of $NO_X$ on a dry basis at 3% $O_2$
$C_{NOx}$ = Total concentration of $NO_X$ (from 9.1)
$C_{O2}$ = Concentration of Oxygen on a dry basis (from 8.1)
17.95 = Ambient $O_2$ less 3%

9.3 When necessary to calculate the mass emission rate of $NO_X$, the molecular weight of $NO_2$ shall be used.

## 10. REPORTING

The data and information shown in Figure 13A-2 shall be reported.

**Figure 13A-2**

| | | |
|---|---|---|
| **Report No.:** _____<br>**Test Date:** _____ | **BAY AREA**<br>**AIR QUALITY MANAGEMENT DISTRICT**<br><br>**Summary of**<br>**Source Test Results** | **Test Times:**<br>**Run A:** _____<br>**Run B:** _____<br>**Run C:** _____ |

| **Source Information** | | **Test Representatives** |
|---|---|---|
| Firm Name and Address | Firm Representative and Title<br><br>Phone No. ( ) | |
| Permit Conditions: | Source:<br><br>Plant No. Permit No.<br>Operates Hr/Day & Day/Yr. | Operating Parameters |
| Applicable Regulations: | | |

## Source Test Results and Comments:

| METHOD | TEST | RUN A | RUN B | RUN C | AVERAGE | LIMIT |
|---|---|---|---|---|---|---|
| | Run time, minutes | | | | | |
| | Stack gas temp., $F^o$ | | | | | |
| ST-13A | Total oxides of nitrogen, uncorrected, ppm | | | | | |
| ST-14 | Oxygen, volume percent | | | | | |
| ST-13A | Total oxides of nitrogen, corrected, ppm | | | | | |

| Test Team Leader Date | Reviewed by Date | Approved By Date |
|---|---|---|
| | | |