

# NITROUS OXIDE

6600

N<sub>2</sub>O

MW: 44.01

CAS: 10024-97-2

RTECS: QX1350000

**METHOD:** 6600, Issue 2

**EVALUATION:** FULL

**Issue 1:** 15 February 1984

**Issue 2:** 15 August 1994

**OSHA :** no standard

**NIOSH:** 25 ppm

**ACGIH:** 50 ppm

(1 ppm = 1.80 mg/m<sup>3</sup> @ NTP)

**PROPERTIES:** gas; BP -88.46 °C; d = 1.53 (air =1)

**SYNONYMS:** hyponitrous acid anhydride; laughing gas.

SAMPLING	MEASUREMENT
<p><b>SAMPLER:</b> AMBIENT AIR OR BAG SAMPLE</p> <p><b>VOL-MIN:</b> at least 2 spectrophotometer cell volumes  <b>-MAX:</b> no maximum volume</p> <p><b>SAMPLE STABILITY:</b> bag samples stable 2 h @ 25 °C</p> <p><b>BLANKS:</b> use uncontaminated air</p>	<p><b>TECHNIQUE:</b> LONG-PATHLENGTH PORTABLE INFRARED SPECTROPHOTOMETER (FIELD READOUT)</p> <p><b>ANALYTE:</b> nitrous oxide</p> <p><b>OPERATION:</b> according to manufacturer's instructions</p> <p><b>ANALYTICAL WAVELENGTH:</b> 4.48 µm</p> <p><b>PATHLENGTH:</b> 0.5 m to 40 m (function of desired concentration range)</p> <p><b>CALIBRATION:</b> closed-loop dilution of N<sub>2</sub>O</p> <p><b>RANGE:</b> 10 ppm to &gt; 1% N<sub>2</sub>O in air</p> <p><b>ESTIMATED LOD:</b> ca. 1 ppm N<sub>2</sub>O @ 10-m pathlength; varies with pressure and instrument</p> <p><b>PRECISION (S<sub>p</sub>):</b> 0.01 [1] (within-instrument)</p>
ACCURACY	
<p><b>RANGE STUDIED:</b> 10 to 1000 ppm</p> <p><b>BIAS:</b> none known</p> <p><b>OVERALL PRECISION (S<sub>r,T</sub>):</b> 0.013 [1] (between-instrument)</p> <p><b>ACCURACY:</b> ± 2.5%</p>	

**APPLICABILITY:** The working range of this method is 10 ppm (v/v) to more than 1% (v/v) N<sub>2</sub>O. This method may be used for the sequential determination of two or more analyses by changing the analytical wavelength and pathlength.

**INTERFERENCES:** In common application (i.e., hospital, dental or veterinary operatory), there are no identified interferences.

**OTHER METHODS:** The criteria document on waste anesthetic gases [2] also describes an infrared method.

**REAGENTS:**

1. Nitrous oxide, 99%, compressed.\*  
NOTE: Required in field for calibration.
2. Air, uncontaminated.

\* See SPECIAL PRECAUTIONS.

**EQUIPMENT:**

1. Spectrophotometer: infrared analyzer, transportable, long pathlength (0.5 to 40 m, as needed for concentration range measured), wavelength 4.48  $\mu\text{m}$ , sample cell of known volume.  
NOTE: Readout drift should be less than 5% full-scale/8-h.
2. Pump to circulate air samples through the spectrophotometer sample cell; flow rate ca. 1 sample cell volume/min.
3. Syringes, gas-tight, 0.1-, 0.5- and 1-mL.
4. Regulator for nitrous oxide.
5. Strip chart recorder, compatible with spectrophotometer (optional).
6. Personal sampling pump, 0.1 to 4 L/min, capable of bag filling, with flexible connecting tubing; and plastic bags, inert and impermeable, clean, various sizes, capacity  $\geq 2$  times spectrophotometer cell volume (optional; for TWA samples).
7. Plastic tubing (optional; for remote, real-time analysis).

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**SPECIAL PRECAUTIONS:** Nitrous oxide supports combustion. Shipment of compressed calibration gas must comply with 49 CFR 1992 regulations regarding shipment of hazardous materials.

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**SAMPLING:**

1. Select one of the following sampling modes according to the desired form of the data:
  - a. **Ambient air.** Pump ambient air at ca. 1 cell volume/min through the spectrophotometer sample cell.  
NOTE 1: Record and integrate the continuous spectrophotometer output signal if data are to be expressed as TWA concentration.  
NOTE 2: Remote air samples may be transported to the spectrophotometer with the use of plastic tubing and a vacuum pump and analyzed in the same manner as ambient air samples.
  - b. **Integrated air samples for TWA determinations.**
    - (1) Evacuate a clean plastic bag.
    - (2) Attach the plastic bag to a personal sampling pump and pump the air to be sampled into the bag at a rate calculated to fill the bag over the duration of the sampling period. Terminate sampling before the bag is 80% full.  
NOTE: The flow rate must remain within  $\pm 5\%$  of the initial setting throughout the sampling period.
    - (3) Analyze the bag sample within 2 h after completion of sampling to minimize loss of analyte by adsorption and permeation.

### INSTRUMENT PREPARATION AND CALIBRATION:

2. Set instrument parameters as required for analysis. Allow sufficient warm-up/equilibration time.
3. Perform on-site multi-point calibration at five or more concentrations over the range 10 to 1000 ppm.
  - a. Zero instrument while recirculating uncontaminated air through sample cell.
  - b. Inject known volume of N<sub>2</sub>O into the sample cell with a gas-tight syringe.  
NOTE: Inject the N<sub>2</sub>O through tubing or a septum attached to the sample cell.
  - c. Calculate concentration, C<sub>s</sub> (ppm), of N<sub>2</sub>O in sample cell:

$$C_s = \frac{\text{Volume of N}_2\text{O injected ( } \mu\text{L )}}{\text{Volume of cell ( L )}}, \text{ ppm.}$$

- d. When instrument reading stabilizes, record meter or recorder deflection.
  - e. Prepare calibration graph (C<sub>s</sub> vs. meter or recorder deflection).
4. Practice routine instrument maintenance.
  - a. Replace septa in a closed-loop system frequently in accordance with manufacturer's recommendations.
  - b. Check and replace, if cloudy, the NaCl windows in the infrared spectrophotometer.  
NOTE: AgBr optics cloud less quickly.
  - c. Follow manufacturer's recommendations for specific routine maintenance.

### MEASUREMENT:

5. Pump air to be analyzed through sample cell to purge the sample cell. Typically, 2 to 3 cell volumes are necessary. When output stabilizes, record meter or recorder reading.
6. Read the concentration of N<sub>2</sub>O in the unknown samples, C<sub>v</sub> (ppm), corresponding to the meter or recorder deflection directly from the calibration graph.
7. Periodically during each day's operation recheck calibration by going to step 2 and repeating three or more points on the calibration graph.

### EVALUATION OF METHOD:

This method has been successfully used in hospital, dental and veterinary operatories. Calibration curves have proven reproducible. Individual data sets have demonstrated statistical comparability in Bartlett's test for homogeneity. Relative standard deviations, s<sub>r</sub>, as low as 0.006 have been seen in replicate calibrations of the same instrument by different individuals in the 10 to 1000 ppm range [1].

### REFERENCES:

- [1] Burroughs, G. E. NIOSH, Division of Physical Sciences and Engineering, unpublished data (1983).
- [2] Criteria for a Recommended Standard...Occupational Exposure to Waste Anesthetic Gases and Vapors, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-140 (1977).

### METHOD WRITTEN BY:

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