

CDC

CENTERS FOR DISEASE CONTROL
AND PREVENTION

NIOSH

ALERT

APRIL 1994

REQUEST FOR ASSISTANCE IN

Controlling Exposures to Nitrous Oxide During Anesthetic Administration



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

DISCLAIMER

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health.

This document is in the public domain and may be freely copied or reprinted.

Copies of this and other NIOSH documents are available from

**Publications Dissemination, DSDTT
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
Fax number: (513) 533-8573**

**For information about this and other occupational safety and health problems, call
1-800-35-NIOSH**

NIOSH ALERT



Request for Assistance in

Controlling Exposures to Nitrous Oxide During Anesthetic Administration

WARNING!

Workers exposed to nitrous oxide (N₂O) may suffer harmful effects.

The National Institute for Occupational Safety and Health (NIOSH) requests assistance in controlling exposures of workers to nitrous oxide (N₂O) during the administration of anesthetic gas in medical, dental, and veterinary operatories. NIOSH concluded in 1977 that exposure to N₂O causes decreases in mental performance, audiovisual ability, and manual dexterity [NIOSH 1977b]. A recent study of workers [Rowland et al. 1992] and several experimental animal studies [Corbett et al. 1973; Vieira 1979; Vieira et al. 1980, 1983] indicate that adverse reproductive effects may also result from chronic exposure to N₂O.

This Alert presents control measures for preventing or greatly reducing exposure to N₂O during the administration of anesthetic gas. These control measures should be part of a comprehensive written safety and health plan for workers. NIOSH requests that safety and health officials,

editors of appropriate journals, manufacturers of anesthetic equipment, union representatives, employers, and managers bring the recommendations in this Alert to the attention of all workers who are at risk.

N₂O is used as an anesthetic agent^{*} in medical, dental, and veterinary operatories. This gas is also used as a foaming agent for whipped cream, an oxidant for organic compounds, a nitrating agent for alkali metals, and a component of certain rocket fuels [Beard 1982; Suruda and McGlothlin 1990].

In 1977, NIOSH published a technical report entitled *Control of Occupational Exposure to*

^{*}In dental operatories, agents that cause conscious sedation (such as N₂O) are commonly referred to as "analgesic agents."

N₂O in the Dental Operatory. This report presented methods for limiting the concentration of waste N₂O to 50 parts per million (ppm) during administration—a limit based on the technical feasibility of existing controls [NIOSH 1977a]. Since publication of this technical report, data collected by NIOSH have shown occupational exposures as high as 300 ppm in hospital operating rooms [NIOSH 1985] and exposures higher than 1,000 ppm in dental operatories equipped with scavenging systems[†] (properly operating scavenging systems have been shown to reduce N₂O concentrations by more than 70%) [McGlothlin et al. 1988, 1990].

To determine why occupational exposures to N₂O are excessive even when scavenging systems are used, NIOSH has studied work practices[‡] and engineering controls[§] for dental operatories. This work environment was chosen because N₂O is frequently used as the sole anesthetic agent in dental operatories and exposures there tend to be more difficult to control than in general operating theaters. Control is more difficult in dental operatories because only the patient's nose is covered during anesthetic administration and scavenging, but both the nose and mouth can be covered in general operating theaters.



Animal studies have shown adverse reproductive effects in female rats exposed to airborne concentrations of N₂O [Corbett et al. 1973; Vieira 1979; Vieira et al. 1980, 1983].

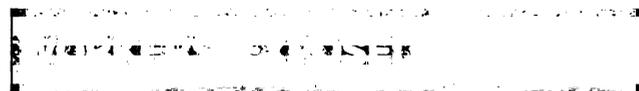
[†]Scavenging systems use local exhaust ventilation to collect waste gases from anesthetic breathing systems and remove them from the workplace.

[‡]Work practices are procedures followed by employers and workers to control hazards.

[§]Engineering controls are hazard controls designed into equipment and workplaces.

Data from these studies indicate that exposure to N₂O during gestation can produce adverse health effects in the offspring.

Several studies of workers have shown that occupational exposure to N₂O causes adverse effects such as reduced fertility [Rowland et al. 1992], spontaneous abortions, and neurologic, renal, and liver disease [Cohen et al. 1980]. A recent study [Rowland et al. 1992] reported that female dental assistants exposed to unscavenged N₂O for 5 or more hours per week had a significant risk of reduced fertility compared with unexposed female dental assistants. The exposed assistants had a 59% decrease in probability of conception for any given menstrual cycle compared with the unexposed assistants. For dental assistants who used scavenging systems during N₂O administration, the probability of conception was not significantly different from that of the unexposed assistants. Since environmental exposures were not measured during these epidemiologic studies, no dose-effect relationship could be established.



More than 424,000 workers (i.e., dentists, dental assistants, and dental hygienists) practice dentistry in the United States [BLS 1990]. In 1983, the American Dental Association (ADA) reported that 35% of all dentists used N₂O to control pain and anxiety in their patients [ADA 1983]. The ADA 1991 *Survey of Dental Practice* indicated that 58% of dentists reported having N₂O anesthetic equipment, and 64% of those practitioners also reported having a scavenging system [ADA 1992]. The percentage of pediatric dentists using N₂O increased from 65% in 1980 to 88% in 1988 [Davis 1988].

The Occupational Safety and Health Administration (OSHA) does not currently have a standard for N₂O.

The NIOSH recommended exposure limit (REL) for N₂O is 25 ppm as a time-weighted average (TWA) during the period of anesthetic administration [NIOSH 1977b]. This REL is intended to prevent decreases in mental performance, audiovisual ability, and manual dexterity during exposures to N₂O. An REL to prevent adverse reproductive effects cannot be established until more data are available.

The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV[®]) for N₂O is 50 ppm as an 8-hour TWA [ACGIH 1993]. The *1991 Documentation of the Threshold Limit Values and Biological Exposure Indices* states that "control to this level should prevent embryofetal toxicity in humans and significant decrements in human psychomotor and cognitive functions or other adverse health effects in exposed personnel" [ACGIH 1991].

A large population of health care workers is potentially exposed to N₂O, and NIOSH has documented cases in which exposures substantially exceed existing RELs. NIOSH has concluded that exposure to N₂O causes decreases in mental performance, audiovisual ability, and manual dexterity. Data from animal studies demonstrate that exposure to N₂O may cause adverse reproductive effects. Studies of workers

exposed to N₂O have reported adverse health effects such as reduced fertility, spontaneous abortion, and neurological, renal, and liver disease. The recommendations in this Alert should therefore be followed to minimize worker exposures.

Engineering controls, work practices, and respirators (when necessary) should be used to minimize the exposure of workers to N₂O. Employers should ensure that their workers are adequately protected from N₂O exposure by taking the following steps:

- Monitor airborne concentrations of N₂O.
- Implement appropriate engineering controls, work practices, and maintenance procedures.
- Institute a worker education program that
 - describes standard operating procedures for all tasks that may expose workers to N₂O, and
 - informs workers about proper work practices, controls, equipment, and protective gear that should be used when working with N₂O.
- Use the guidelines in the following section to minimize worker exposures to N₂O.

Exposure Monitoring

Exposure monitoring should be the first step in developing work practices and worker

education programs, since measurements of N₂O are needed to determine the type and extent of controls that are necessary. Follow the guidelines below to minimize worker exposures:

- Monitor for N₂O when the anesthetic equipment is installed and every 3 months thereafter.
- Include the following types of monitoring:
 - Leak testing of equipment
 - Monitoring of air in the worker's personal breathing zone
 - Environmental (room air) monitoring
- Prepare a written monitoring and maintenance plan for each facility that uses N₂O. This plan should be developed by knowledgeable persons who consider the equipment manufacturers' recommendations, frequency of use, and other circumstances that might affect the equipment.
- Perform air monitoring by gas-bag sampling [NIOSH 1984] or real-time sampling [McGlothlin et al. 1989].

When real-time sampling is conducted to obtain personal exposure data, attach the sampling train to the lapel of the worker on the side closest to the patient; N₂O concentrations in this location are most representative of those in the worker's breathing zone. Diffusive samplers (referred to as passive dosimeters) are commercially available and may be useful as initial indicators of exposure [Bishop and Hossain 1984].

Engineering Controls and Maintenance Procedures

The following engineering controls and maintenance procedures have been shown to be feasible and effective in reducing exposure to N₂O during anesthetic administration.

Anesthetic delivery. Excessive exposure to N₂O may occur as a result of leaks from the anesthetic delivery system during administration [McGlothlin et al. 1989]. The rubber and plastic components of the anesthetic equipment are potential sources of N₂O leakage because they may be degraded by the N₂O and the oxygen as well as by repeated sterilization.

Figure 1 illustrates sources of possible leaks from anesthetic delivery systems in dental operatories. These sources include leaks from the high-pressure connections—that is, from the gas delivery tanks, the wall connectors, the hoses connected to the anesthetic machine, and the anesthetic machine (especially the on-demand valve). Low-pressure leaks occur from the connections between the anesthetic flowmeter and the scavenging mask. This leakage is due to loose-fitting connections, loosely assembled or deformed slip joints and threaded connections, and defective or worn seals, gaskets, breathing bags, and hoses.

Take the following steps to control N₂O exposure from anesthetic delivery systems:

- Use connection ports with different-diameter hoses for N₂O and O₂ to reduce the possibility of incorrectly connecting the gas delivery and scavenging hoses [Dorsch and Dorsch 1984].

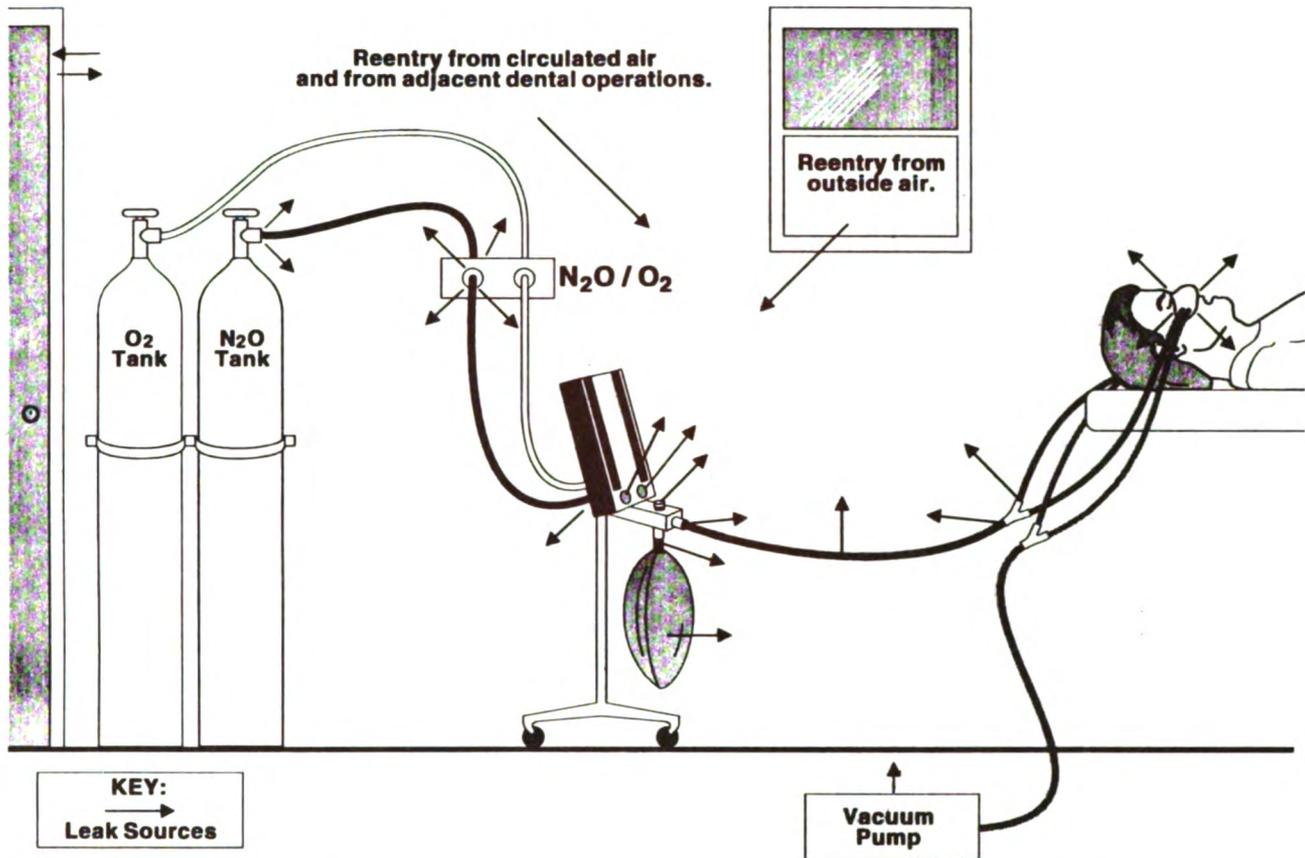


Figure 1. Sources of leaks from anesthetic delivery systems in dental operatories.

- Check all rubber hoses, connections, tubing, and breathing bags daily and replace them when damaged or when recommended by the manufacturer.
- Following visual inspection, perform leak testing of the equipment and connections by using a soap solution to check for bubbles at high-pressure connections. For a more thorough inspection of all connectors, use a portable infrared spectrophotometer (such as a Miran[®] 1A or 1B) calibrated for N₂O detection [NIOSH 1984].
- Check both high- and low-pressure connections (such as O-rings) regularly, as they may become worn; replace them periodically, according to the manufacturer's recommendations.
- Evaluate the N₂O and oxygen mixing system for leaks when it is first installed and periodically thereafter, according to the manufacturer's recommendations.
- Ensure that gas cylinders are safely handled, used, and stored as specified by the National Research Council [NRC 1981] and as required by OSHA [29 CFR^{**} 1910.101].

Scavenging systems. Control of N₂O at the scavenging mask is the next priority

^{**}Code of Federal Regulations. See CFR in references.

after control of N₂O leakage from the anesthetic equipment. Leakage from the scavenging mask can be one of the most significant sources of N₂O exposure because the breathing zone of a dentist or dental assistant is within inches of the mask [McGlothlin et al. 1989]. NIOSH research has reported breathing-zone concentrations of N₂O above 1,000 ppm [McGlothlin et al. 1988].

Take the following steps to control N₂O exposure from anesthetic scavenging systems:

- Supply scavenging masks in a variety of sizes so that the mask always fits comfortably and securely over the patient's nose or face.
- Use an automatic interlock system to assure that the N₂O cannot be turned on unless the scavenging system is also activated. N₂O should never be used without a properly operating scavenging system.
- Make sure that the scavenging system exhaust rates (flow rates) are approximately 45 liters per minute (L/min) to minimize leakage of N₂O. Flow rates of less than 40 L/min may result in significant leakage around the mask [NIOSH 1977a]. Monitor the flow rate with a flowmeter that is
 - validated to measure air flow within 5% of actual air flow,
 - permanently connected to the scavenging system vacuum line, and
 - positioned so that it is always visible to the operator.

Maintain the flowmeter by cleaning and recalibrating it according to the manufacturer's recommendations.

- Use scavenging vacuum pumps that are powerful enough to maintain a scavenging flow rate of at least 45 L/min at each nasal mask regardless of the number of scavenging units in use at one time.
- Vent N₂O from all scavenging vacuum pumps to the outside of the building away from fresh air intakes, windows, or walkways. Scavenging system exhaust should not be vented into a recirculating ventilation system.

Room Ventilation. Take the following steps to assure that the ventilation system effectively removes waste N₂O:

- If concentrations of N₂O are above 25 ppm in work areas, increase the air flow into the room or increase the percentage of outside air to allow for more air mixing and further dilution of the anesthetic gas. Maintain a balanced air supply and exhaust system so that N₂O does not contaminate adjacent areas.
- If concentrations of N₂O are still above 25 ppm, use supplementary local ventilation^{††} in conjunction with a scavenging system to reduce N₂O exposure in the operatory [Mickelsen et al. 1993]. The effectiveness of this ventilation depends on its location with respect to the patient and the airflow rates. Do not work between the patient and the exhaust duct, where contaminated air would be drawn through the worker's breathing zone.

^{††}Local ventilation is the use of a hood or duct to capture N₂O at the source.

- Dilute N₂O and remove contaminated air from the work area by placing fresh-air vents in the ceiling; direct the supply of fresh air toward the floor and the operating area. Place exhaust-air vents at or near the floor.

Work Practices

Use the following work practices to control N₂O exposures:

- Inspect the anesthetic delivery systems and all connections before starting anesthetic gas administration. Make sure that breathing bags, hoses, and clamps are in place before turning on the anesthetic machine.
- Connect the scavenging mask properly to the gas delivery hose and the vacuum system.
- Do not turn on the machine delivering N₂O until
 - the vacuum system scavenging unit is operating at the recommended flow rate of 45 L/min, and
 - the scavenging mask is secured over the patient's nose or face.
- Fasten the mask according to the manufacturer's instructions to prevent leaks around the mask during gas delivery.
- Do not fill the breathing bag to capacity with N₂O; an overinflated bag can cause excessive leakage from the scavenging mask. The breathing bag should collapse and expand as the patient breathes. This bag activity shows that the proper

amounts of N₂O and air are being delivered to the patient.

- Flush the system of N₂O after surgery by administering oxygen to the patient through the anesthetic equipment for at least 5 minutes before disconnecting the gas delivery system.
- Encourage patients to minimize talking and mouth-breathing during dental surgery. When mouth-breathing is apparent, avoid the patient's breathing zone to the extent possible.

Respiratory Protection

Workers should wear respiratory protection when N₂O concentrations are not consistently below 25 ppm; however, practical considerations may prevent them from wearing such protection. Therefore, it is *essential* that employers use the engineering controls and work practices described in this Alert to reduce N₂O concentrations below 25 ppm.

When N₂O concentrations are not consistently below 25 ppm, workers should take the following steps to protect themselves:

- Wear air-supplied respirators. Air-purifying respirators (that is, respirators that remove N₂O from the air rather than supply air from a clean source) should not be used because respirator filters do not efficiently remove N₂O.

As specified by the *NIOSH Respirator Decision Logic* [NIOSH 1987b], the minimum level of protection for an air-supplied respirator is provided by a half-mask respirator operated in the demand or

continuous-flow mode.[‡] More protective air-supplied respirators are described in the *NIOSH Respirator Decision Logic*.

- When respirators are used, the employer must establish a comprehensive respiratory protection program as outlined in the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a] and as required by the OSHA respiratory protection standard [29 CFR 1910.134]. Important elements of this standard are
 - an evaluation of the worker's ability to perform the work while wearing a respirator,
 - regular training of personnel,
 - periodic environmental monitoring,
 - respirator fit testing,
 - maintenance, inspection, cleaning, and storage, and
 - selection of proper NIOSH-approved respirators.

The respiratory protection program should be evaluated regularly by the employer.

Barbara L. Dames and James D. McGlothlin, Ph.D., were the principal contributors to this Alert. Comments, questions, or requests

[‡]Note: The assigned protection factor (APF) for this class of respirator is 10. The APF indicates the level of protection provided by a class of respirator [NIOSH 1987b]. An APF of 10 means that the respirator should reduce the air concentration of N₂O for the wearer by a factor of 10 (or to 10% of the concentration without respiratory protection).

for additional information should be directed to the following:

Dr. Laurence J. Doemeny
Acting Director, Division of Physical Sciences
and Engineering
NIOSH
4676 Columbia Parkway
Cincinnati, OH 45226
Telephone: (513) 841-4321

We greatly appreciate your assistance in protecting the health of U.S. workers.



Richard A. Lemen, Ph.D.
Acting Director, National Institute for
Occupational Safety and Health
Centers for Disease Control
and Prevention

ACGIH [1991]. Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, pp. 1134-1138; documentation for nitrous oxide revised as of 1992.

ACGIH [1993]. 1993-1994 threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Hygienists.

ADA [1983]. Dentists' desk reference: materials, instruments and equipment. 2nd

ed. Chicago, IL: American Dental Association, pp. 413–414.

ADA [1992]. The 1991 survey of dental practice: general characteristics of dentists. Chicago, IL: American Dental Association, p. 11.

Beard RR [1982]. Nitrous oxide, N₂O. In: Clayton GD, Clayton FE, eds. *Patty's industrial hygiene and toxicology*. 3rd rev. ed. Vol. 2C. New York, NY: John Wiley and Sons, pp. 4096–4097.

Bishop EC, Hossain MA [1984]. Field comparison between two nitrous oxide (N₂O) passive monitors and conventional sampling methods. *Am Ind Hyg Assoc J* 45(12):812–816.

BLS [1990]. *Outlook 2000*. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2352, pp. 51, 54.

CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

Cohen EN, Gift HC, Brown BW, Greenfield W, Wu ML, Jones TW, et al. [1980]. Occupational disease in dentistry and chronic exposure to trace anesthetic gases. *J Am Dent Assoc* 101(1):21–31.

Corbett TH, Cornell RG, Endres JL, Millard RI [1973]. Effects of low concentrations of nitrous oxide on rat pregnancy. *Anesthesiology* 39:299–301.

Davis MJ [1988]. Conscious sedation practices in pediatric dentistry: a survey of members of the American Board of Pediatric Dentistry College of Diplomates. *Pediatr Dent* 10(4):328–329.

Dorsch JA, Dorsch SE [1984]. *Understanding anesthesia equipment: construction, care and complications*. Baltimore, MD: Williams & Wilkins, pp. 24–26.

McGlothlin JD, Jensen PA, Cooper TC, Fischbach TJ, Fairfield CL [1990]. In-depth survey report: control of anesthetic gases in dental operatories at University of California at San Francisco Oral Surgical Dental Clinic, San Francisco, CA. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health, Report No. ECTB 166–12b.

McGlothlin JD, Jensen PA, Todd WF, Fischbach TJ [1988]. Study protocol: control of anesthetic gases in dental operatories. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering.

McGlothlin JD, Jensen PA, Todd WF, Fischbach TJ, Fairfield CL [1989]. In-depth survey report: control of anesthetic gases in dental operatories at Children's Hospital Medical Center Dental Facility. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Report No. ECTB 166–11b.

Mickelsen RL, Jacobs DE, Jensen PA, Middendorf PJ, O'Brien DM, Fischbach TJ, et al. [1993]. Auxiliary ventilation for the control of nitrous oxide in a dental clinic. *Appl Occup Environ Hyg* 8(6):564–570.

NIOSH [1977a]. Control of occupational exposure to N₂O in the dental operatory. Cincinnati, OH: U.S. Department of Health,

Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-171.

NIOSH [1977b]. Criteria for a recommended standard: occupational exposure to waste anesthetic gases and vapors. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-140.

NIOSH [1984]. Nitrous oxide: Method 6600. In: Eller PM, ed. NIOSH manual of analytical methods. 3rd ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 84-100.

NIOSH [1985]. Health hazard evaluation report: Hennepin County Medical Center, Minneapolis, MN. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, HETA 84-046-1584.

NIOSH [1987a]. Guide to industrial respiratory protection. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-116.

NIOSH [1987b]. NIOSH respirator decision logic. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-108.

NRC (National Research Council) [1981]. Prudent practices for handling hazardous chemicals in laboratories. Washington, DC: National Academy Press, pp. 75-78.

Rowland AS, Baird DD, Weinberg CR, Shore DL, Shy CM, Wilcox AJ [1992]. Reduced fertility among women employed as dental assistants exposed to high levels of nitrous oxide. *New Eng J Med* 327(14):993-997.

Suruda AJ, McGlothlin JD [1990]. Fatal abuse of nitrous oxide in the workplace. *J Occup Med* 32(8):682-684.

Vieira E [1979]. Effect of the chronic administration of nitrous oxide 0.5% to gravid rats. *Br J Anaesth* 51:283-287.

Vieira E, Cleaton-Jones JP, Austin JC, Moyes DG, Shaw R [1980]. Effects of low concentrations of nitrous oxide on rat fetuses. *Anesth and Analgesia* 59(3):175-177.

Vieira E, Cleaton-Jones P, Moyes D [1983]. Effects of low intermittent concentrations of nitrous oxide on the developing rat fetus. *Br J Anaesth* 55:67-69.

Controlling Exposures to Nitrous Oxide During Anesthetic Administration

WARNING!

Workers exposed to nitrous oxide (N₂O) may suffer harmful effects.

Take the following steps to protect yourself from waste N₂O in the workplace:

- 1. Be aware that N₂O may cause the following health effects:**
 - Decreases in mental performance, audiovisual ability, and manual dexterity
 - Adverse reproductive effects
- 2. Make sure that the following monitoring procedures are performed when the anesthetic equipment is installed and every 3 months thereafter:**
 - Leak testing of equipment
 - Monitoring of air in the worker's personal breathing zone
 - Environmental (room air) monitoring
- 3. Prevent leakage from the anesthetic delivery system through proper maintenance and inspection of equipment. Eliminate or replace the following:**
 - Loose-fitting connections
 - Loosely assembled or deformed slip joints and threaded connections
 - Defective or worn seals, gaskets, breathing bags, and hoses
- 4. Control waste N₂O with a well-designed scavenging system that includes the following:**
 - Securely fitting masks
 - Sufficient flow rates for the exhaust system
 - Properly vented vacuum pumps
- 5. Make sure that the room ventilation is effectively removing waste N₂O. If concentrations of N₂O are above 25 ppm, take the following steps:**
 - Increase the airflow into the room.
 - Use supplemental local ventilation to capture N₂O at the source.

For additional information, see *NIOSH Alert: Request for Assistance in Controlling Exposures to Nitrous Oxide During Anesthetic Administration* [DHHS (NIOSH) 94-100], or call 1-800-35-NIOSH. Single copies of the Alert are available free from the following:

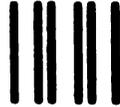
Publications Dissemination, DSDTT
National Institute for Occupational Safety
and Health
4676 Columbia Parkway
Cincinnati, OH 45226
Fax number: (513) 533-8573



U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety
and Health

Please tear out and post. Distribute copies to workers.

Official Business
Penalty for Private Use \$300



**NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES**

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 99110 ATLANTA, GA 30333

POSTAGE WILL BE PAID BY ADDRESSEES:

Centers for Disease Control
National Institute for Occupational Safety and Health
NIOSH Publications Dissemination
Division of Standards Development and Technology Transfer
4676 Columbia Pky
Cincinnati, OH 45226-9966



READER RESPONSE CARD

Dear Reader:

Please take a few minutes to help us evaluate this publication. Thank you.

Are you a manager _____ employee _____ educator _____ safety professional _____
occupational health professional _____ health care worker _____ researcher _____
other (specify) _____

Do you work in private industry _____ government agency _____
labor organization _____ academia _____ own business _____ other (specify) _____

How did you read this publication?

Cover-to-cover _____ Sections of interest only _____ Introduction only _____

How was the information in this publication used?

To change work environment or procedure _____ To assist in ongoing or new research _____
To change training or course curriculum _____ Not used _____

Other (briefly describe) _____

Other comments _____

Controlling Exposures to N₂O During Anesthetic Administration



NIOSH

**Delivering on the Nation's promise:
Safety and health at work
For all people
Through prevention**

DHHS (NIOSH) Publication No. 94-100