

Office of Research Services

# Nitric Oxide

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**Technical Assistance Branch  
Division of Occupational Health and Safety  
Office of Research Services**

**Clinical Center Nitric Oxide Surveillance Program**

**INTRODUCTION**

A nitric oxide nitric oxide surveillance program has been established to:

- 1) Identify and quantify exposure levels of workers in the Clinical Center potentially exposed to nitric oxide
- 2) Provide information on the effectiveness of the controls that are being used to minimize exposures.

Surveys serve to provide documentation of surveillance activities to The Joint Commission (TJC). The program is maintained by the Technical Assistance Branch (TAB) of the Division of Occupational Health and Safety (DOHS). Medical surveillance of NIH employees is provided by the Occupational Medical Service (OMS). Personnel in the Clinical Center are covered by this protocol. All other NIH laboratories where potential nitric oxide exposure results from the handling and use of nitric oxide are covered by the Occupational Safety and Health Administration (OSHA) Laboratory Standard, 29 CFR 1910.1450.

Nitric oxide, NO [CAS 10102-43-9] is a colorless compressed gas. Synonyms include: nitrogen monoxide and mononitrogen monoxide. Nitric oxide is a strong oxidant which can ignite or explode on contact with combustible materials. In contact with air it will react to form nitrogen dioxide.

Short term exposure to nitric oxide causes irritation to the skin, eyes and respiratory system. Exposure can also cause nausea, vomiting, stomach pain, chest pain, difficulty breathing, headache, dizziness, bluish skin color, and lung congestion.

**DEFINITIONS**

For purposes of this program, the following definitions shall apply

Employee exposure – means the exposure to airborne nitric oxide that would occur without protection provided by use of a respirator.

Permissible exposure limit (PEL) – this is the maximum concentration, determined as an 8-hour TWA or 15 minute STEL (defined below), to which an employee in the workplace may be exposed.

Supervisor – means the NIH/IC Director, designated representative, Research Director, Project Director, Branch Chief, Section Chief, or other immediate supervisor of an employee.

Short Term Exposure Limit (STEL) – is defined as a 15-minute time-weighted average (TWA) exposure which should not be exceeded at any time during a workday.

Threshold Limit Value (TLV) – is defined as an airborne concentration of a chemical substance and represents the conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. The TLV is established through the American Conference of Governmental Industrial Hygienists (ACGIH).

## **OCCUPATIONAL EXPOSURE CRITERIA**

For evaluating employee exposures to nitric oxide, the NIH uses exposure criteria established by both the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH). OSHA has set a permissible exposure limit (PEL) of 25 ppm as an 8 hour time-weighted-average (TWA) for nitric oxide. The Threshold Limit Value (TLV), an 8 hour TWA workday exposure level from ACGIH, is also 25 ppm.

## **WORKPLACE EVALUATION**

All work sites in the NIH Clinical Center where nitric oxide is used should be identified and initially evaluated using the Nitric Oxide Workplace Evaluation Sheet (attached as Appendix 1) to determine if workers in the area may be exposed to nitric oxide. The initial evaluation should be conducted by the Clinical Center Safety Officer or designee. All locations should be documented in Table 1.

A copy of the initial evaluation should be given to the TAB, DOHS. If, based on the initial evaluation, it is determined that workers are potentially exposed to nitric oxide levels that exceed the OSHA or ACGIH occupational exposure criteria, then the workplace will be monitored by TAB on an annual basis.

## **SAMPLING & ANALYTICAL METHODS**

Sampling media capable of detecting nitric oxide will be used to take area and personal samples. Direct-reading instruments may also be used; and, these devices will be calibrated before and after use. The sampling media will be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory.

## **MONITORING PROCEDURE**

### a. Frequency of Monitoring

Monitoring will be conducted at Clinical Center work sites where a workplace evaluation has determined that workers are potentially exposed to nitric oxide levels that exceed the OSHA or ACGIH occupational exposure criteria. Monitoring will be carried out on a yearly basis. If two consecutive surveys are completed without any recorded exposures, monitoring will be discontinued at that location. Monitoring will be re-instituted at any work site if any symptoms of exposure to nitric oxide are reported or there is a change in equipment or personnel.

### b. Monitoring Locations

Monitoring locations, including procedures and contact persons, are listed in Table 1. It is the responsibility of the Clinical Center Safety Officer and /or Clinical Center Safety Committee to provide the TAB with any additions to the list of nitric oxide usage areas within the Clinical Center as they appear in Table 1. The locations listing will be reviewed annually.

### c. Field Sampling

Field sampling should represent worst-case situations. Area and personal sampling should be taken during the survey. Direct-reading instruments may also be used. Placement of monitoring equipment and passive dosimeters will be at the discretion of the industrial hygienist conducting the sampling. Information related to the sampling activity and sample locations will be documented.

### d. Ventilation

The directional air flow of the work site, with respect to the corridor, will also be determined and documented. Any local exhaust ventilation (LEV) devices used will be evaluated and certified by TAB to determine that they meet LEV criteria established by NIH.

## **PERSONAL PROTECTIVE EQUIPMENT**

In those locations or during those procedures where it is determined by monitoring that nitric oxide levels exceed the exposure criteria, appropriate engineering controls will be instituted to lower nitric oxide exposures.

## **TRAINING**

Training and information on the hazards of nitric oxide will be provided by the area supervisor to those employees working in locations where exposure levels exceed exposure criteria.

## **REPORTS**

Written reports will be prepared by the TAB as soon as possible after receipt of the laboratory results and sent to the appropriate supervisor and monitored employee(s) in each location (see Table 1). Reports will include:

- 1) Name of person conducting monitoring
- 2) Date survey was conducted
- 3) Sampling and analytical method used
- 4) Work site ventilation characteristics at the time of sampling
- 5) Monitoring results
- 6) Any personal protective equipment worn
- 7) Recommendations for corrective action, if required.

It is the responsibility of the Supervisor in each location to initiate and to complete the recommendations made in the report. Implementation of recommendations shall be coordinated by the Clinical Center Safety Officer and/or Supervisor.

In the event that personal monitoring of NIH employees for nitric oxide measures concentrations exceeding the exposure criteria, employees will be notified in writing, of the results of the monitoring within fifteen (15) days of the results being received from the analytical laboratory. The written notification will also describe procedures or changes being instituted to correct the overexposure.

TAB will maintain records of monitoring activity.

## **MEDICAL SURVEILLANCE**

NIH workers who are exposed to nitric oxide in concentrations exceeding the exposure criteria will be referred to the OMS for evaluation. In these instances, copies of the workplace evaluation and monitoring results will be sent to the Medical Director, OMS.

## **RECORDKEEPING**

TAB will maintain and update records of all monitoring data obtained to measure employee exposures. The record includes:

- a.) Date measurements were obtained.

- b.) Operation or procedure being monitored.
- c.) Method of sampling and analysis used.
- d.) Number, duration, time, and results of samples taken.
- e.) Types of protective equipment used.
- f.) Employee names, IC, area supervisor, job classification, and exposure estimate of the employee whose exposures are represented by the actual monitoring results.

## **REFERENCES**

1. Charney, William, and Joseph Schirmer (eds.), Essentials of Modern Hospital Safety; Vol. 1-3, Lewis Publishers, Ann Arbor, Michigan, 1994.
2. Threshold Limit Values for Chemical Substances and Physical Agents, 2017, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
3. Documentation of the Threshold Limit Values and Biological Exposure Indices, 6th edition, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
4. Safety Data Sheet (MSDS) for Nitric Oxide, SDS # 66, Effective Date 12/16/02, Matheson Tri-Gas, Inc., Parsippany, New Jersey.
5. Pocket Guide to Chemical Hazards, National Institutes for Occupational Safety and Health (NIOSH), Cincinnati, Ohio, <https://www.cdc.gov/niosh/npg/npgd0448.html>, retrieved 2-28-2018

**Table 1**

Locations, Supervisors and Report Recipients			
Active			
Location	Supervisor	IC	Report Recipients
Catheterization Lab - Protocol 11-H-0091 and 95-H-0047	TBD	CC	PI (TBD) Dr. Michele Evans
5SE - Protocol 17-H-0169	Dr. Ken Olivier	CC	PI (TBD) Dr. Michele Evans
Critical Care Medicine Department	TBD	CC	PI (TBD) Dr. Michele Evans
Inactive			
Pentamidine Suite CRC/3-3640 SW (Monitoring performed July 2008)— protocol no longer active	Jim Nichols	CC	Jim Nichols & Kevin Cole
CRC/3-3650 SW (Monitoring performed August 2009)	Gregory Kato	CC	Michele Evans Gregory Kato Marlene Peters Lawrence

## Appendix 1

### Nitric Oxide Workplace Evaluation Sheet

Building: \_\_\_\_\_ Room: \_\_\_\_\_ IC:

Supervisor: \_\_\_\_\_ Telephone #:

Number of employees who work in area:

Describe any reports of eye, skin, or respiratory tract irritation:

Procedure(s) where nitric oxide is used:

Engineering controls used in area:

Personal protective equipment used: