Office of Research Services

Waste Anesthetic Gas

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Table of Contents

1.0 ACRONYMS AND DEFINITIONS 3
2.0 INTRODUCTION 7
2.1 Purpose 7
2.2 Scope and Applicability 8
3.0 ROLES AND RESPONSIBILTIES 9
3.1 Supervisor 9
3.2 Employee 10
3.3 Safety Specialist 11
3.4 WAG Program Manager 12
4.0 EXPOSURE LIMITS (UPDATED 12/22/2020) 15
4.1 Requests for Exemption 15
5.0 PROGRAM ELEMENTS 16
5.1 Exposure Monitoring 16
5.1.1 Identification of Exposed Employees 16
5.1.2 Initial Monitoring 16
5.2 Equipment and Methodology 17
5.3 Leak Tests and Full Surveys 17
5.4 How to schedule a Leak Test or Survey 18
5.5 Emergency Response: 18
5.5.1 Acute Exposure Symptoms 18
5.5.2 Mild Symptoms, Large Spill 19
5.5.3 Mild Symptoms, Small Spill 19
6.0 EMPLOYEE TRAINING 20
7.0 INTERNAL REVIEW 20
8.0 REFERENCES 22

Attachment 1: WAG Fact Sheet and Checklist
Attachment 2: WAG Leak Test Form
Attachment 3: WAG Stickers
Attachment 4: Common places for WAG leaks

1.0 ACRONYMS AND DEFINITIONS

Action Level (AL)

Action Levels (ALs) are used by OSHA and NIOSH to express a health or physical hazard. They indicate the level of a harmful or toxic substance/activity which requires medical surveillance, increased industrial hygiene monitoring, or biological monitoring. At NIH, Action Levels are generally half the value of the NIH exposure limits.

As Low As Reasonably Achievable (ALARA)

ALARA means making every reasonable effort to maintain exposures as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations.

Business Day

Monday through Friday, excluding Federal Holidays or unforeseen extreme events such as government shut-downs, terrorist attacks, etc. that close the facility down.

Ceiling Limits

A ceiling limit is the concentration limit of potentially harmful substances, or its upper value to which a worker may be exposed.

Industrial Hygienist

An individual with a strong background in Industrial Hygiene; either via certification or formal education in the subject, in conjunction with hands-on experience in the field of occupational health and safety. Generally, IHs will be the people conducting leak tests or surveys.

Leak Test

Measurement of Waste Anesthetic Gas (WAG) levels using real-time monitoring equipment. The goal of leak tests is to identify whether or not the WAG equipment is leaking. Leak Tests do **not** generate formal reports, just records of whether or not a location passed. Failed leak tests result in additional appointments and corrective actions until the unit passes or the unit is decommissioned. Leak Tests at the NIH involve mock-ups of the worst-case/highest expected exposure periods of a scenario, and a few minutes afterwards to determine if the WAG clears sufficiently quickly, or if there is build-up. Determination of what the "worst-case/highest expected exposure periods" are, is done by the IH in conjunction with the Point of Contact for each vaporizer.

"NIH-Set"

The preface of "NIH-Set" denotes the difference between OSHA requirements (regulatory compliance) and NIH-Set goals. NIH-Set preferences are always as protective as, or more protective than OSHA requirements. They serve to trigger actions internal to NIH, which

flag possible negative trends and ensure workers are not overexposed. NIH-Set preferences are NIH programmatic limits, and are reviewed annually and compared against industry best practices, as well as newly available information. Adjustments are made appropriately by the Program Manager for that program.

N2O

Nitrous oxide, a commonly used anesthetic gas, commonly known as laughing gas or nitrous.

Occupational Exposure Limit (OEL)

An occupational exposure limit is an upper limit on the acceptable concentration of a hazardous substance in workplace air for a particular material or class of materials. It is typically set by competent national authorities and enforced by legislation to protect occupational safety and health.

Permissible Exposure Limit (PEL)

A PEL is a limit that is legally enforceable under OSHA. PEL is usually given as a time-weighted average (TWA) representing the average exposure, typically over an 8 hour period. Some PELs may also be listed as Short Term Exposure Limits (STELs) or ceiling limits. OSHA (29 CFR part 1910 subpart Z) sets PELs to protect workers against the health effects of exposure to hazardous substances. The PELs are limits on the amount or concentration of a substance in the air. The basic exposure limits are defined as the concentration of a chemical in air to which nearly all individuals can be exposed without adverse effects for an 8-hour work-day over a 30 year career. The numbers are usually expressed in parts per million (ppm) or mg/m3.

Pregnancy Risk Groups (based off FDA research and information)

Category A

Adequate and well-controlled studies have failed to demonstrate a risk to the fetus in the first trimester of pregnancy (and there is no evidence of risk in later trimesters).

Category B

Animal reproduction studies have failed to demonstrate a risk to the fetus and there are no adequate and well-controlled studies in pregnant women.

Category C

Animal reproduction studies have shown an adverse effect on the fetus and there are no adequate and well-controlled studies in humans, but potential benefits may warrant use of the chemical in pregnant women despite potential risks.

Category D

There is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience or studies in humans, but potential benefits may warrant use of the chemical in pregnant women despite potential risks.

Category X

Studies in animals or humans have demonstrated fetal abnormalities and/or there is positive evidence of human fetal risk based on adverse reaction data from investigational or marketing experience, and the risks involved in use of the chemical in pregnant women clearly outweigh potential benefits.

Source: Content and Format of Labeling for Human Prescription Drug and Biological Products; Requirements for Pregnancy and Lactation Labeling (Federal Register/Vol. 73, No. 104/Thursday, May 29, 2008)

"Pregnant Worker"

A Pregnant Worker is an employee who has self-declared in writing that they are pregnant to their supervisor, OMS, or DOHS and has granted permission for those three groups to share that information for the purpose of protecting the worker from overexposure during pregnancy, during post-partum recuperation, and during breastfeeding.

NIH is not responsible for any worker protection beyond that applied to general non-Pregnant Workers, if the employee does not declare their status with DOHS, OMS, and whomever is in charge of their job-task assignments, because all three groups are required to effectively implement worker protection at levels sufficiently protective for fetal development.

DOHS strongly recommends moving the Pregnant Worker away from contact with potentially hazardous substances or situations as soon as a pregnancy has been declared, even prior to DOHS's official survey or report. DOHS's report may reveal that with sufficient engineered protections and administrative controls, some of the hazardous tasks may still continue under close surveillance. However, work with such substances and tasks should not occur until DOHS has sent out the final report stating that it is safe to do so, DOHS has verified that appropriate control measures are in place, and that those control measures bring the exposure levels down sufficiently.

Recommended Exposure Limit (REL)

The REL is an occupational exposure limit that has been recommended by the United States National Institute for Occupational Safety and Health to the Occupational Safety and Health Administration (OSHA) for adoption as a permissible exposure limit.

Responsible Individual

The individual responsible for a particular piece of equipment, space, process, or work. The individual may also be someone temporarily authorized to be the steward of that equipment, space, or process, as long as the designation was documented and communicated prior to the new Responsible Individual utilizing his or her new authority.

Short Term Exposure Limit (STEL)

A short-term exposure limit (STEL) is the acceptable average exposure over a short period of time, usually 15 minutes as long as the time-weighted average is not exceeded. STEL is a term used in occupational health, industrial hygiene and toxicology.

Similar Exposure Group (SEG)

A group of workers having the same general exposure profile for the agent(s) being studied because of the similarity and frequency of the tasks they perform, the materials and processes with which they work, and the similarity of the way they perform those tasks.

Survey/"Full-Survey"

An in-depth review of the processes and procedures taking place in a work area, which are likely to impact a chemical exposure of interest. Dosimeters are placed to determine personnel exposure. Direct reading instrument may also be used. [See Chapter 4.2 on Surveys and Leak Tests.] Full Surveys usually result in a write-up documenting the area readings, personnel exposure, and recommendations.

Surveyor

The individual responsible for conducting the survey or leak test to NIH's requirements.

In the case of WAG full surveys, someone with a safety and health background, three months of hands-on work experience with the NIH WAG Program, ***and*** a CSP, CIH, or similar safety-related certification or educational background indicative of technical expertise in sampling methodology, the fundamental concepts/approaches in safety and occupational health, the fundamentals of toxicology and chemistry, and a strong comprehension of human physiology.

In the case of WAG leak tests, someone with three months of hands-on safety and health work experience at NIH assisting the Program Manager during WAG surveys and leak tests ***or*** someone with certification(s) and prior work experience in safety and health.

Short Term Exposure Limit (STEL)

An acceptable maximum peak concentration that should not be exceeded for short time periods.

Alert-Tag

The objective of an Alert-Tag is to make the user aware that a piece of equipment is faulty and should not be used. Alert-Tags for WAG are silver, red, and yellow, and are always placed on a highly visible portion of the equipment or in a way that directly interferes with its operation (ex: on the "on" switch of a vaporizer or between the lid and the base of an induction chamber.)

Threshold Limit Value (TLV)

A threshold limit value, set by the American Conference of Governmental Industrial Hygienists (ACGIH). It is the limit of exposure to a chemical substance that a worker can be exposed to, day after day (assumes an 8 hour workday), without adverse health effects.

TLVs are estimates based on the known toxicity of a chemical substance in humans or animals given the currently available analytical and technological resources. TLVs are then developed as recommendations or guidelines and are intended to be interpreted and used by a person trained in the discipline of industrial hygiene.

Time Weighted Average (TWA)

A time weighted average (TWA) is the average exposure within the workplace to any hazardous contaminant or agent using the baseline of an 8 hour per day or 40 hours per week work schedule. ACGIH's TLV-TWA reflects the maximum average exposure to such hazardous contaminants to which workers may be exposed without experiencing significant adverse health effects over the standardized work period.

Vaporizer

A piece of equipment that mixes anesthetic(s) with a carrier gas. In the veterinary areas, most of the vaporizers used are plenum vaporizers that use positive pressure and uni-directional. There are also draw-over and dual circuit WAG systems.

WAG "High Risk" Occurrences

Any time the air from the pathway for WAG from vaporizer to final capture device (charcoal canister, fumehood, downdraft table, etc.) is interrupted and flows into the breathing zone of any individuals in the area, it is considered "high risk" for exposure. The overall level of risk is determined by how often that occurs, how long that exposure is, and how frequent the event is.

"Working Level" Knowledge

The individual understands all of the general concepts in a given subject area, where to get additional details, the critical details of that topic, and other small details that might serve as a warning of a potentially hazardous situation.

2.0 INTRODUCTION

2.1 Purpose

The Office of Research Services (ORS), Division of Occupational Health and Safety (DOHS), has established a *Waste Anesthetic Gas (WAG) Surveillance Program* at the NIH to:

A. Identify and eliminate occupational exposures to waste anesthetic gases at the NIH. If it is impossible to remove exposure completely, *then* quantify and reduce occupational exposure levels to safe levels.

B. Provide information and recommendations for engineering controls, work practices, and on occasion, personal protective equipment (PPE) that are effective for minimizing exposures.

Potential health effects from occupational exposure to some of the newer anesthetics, such as isoflurane (the most commonly used WAG at NIH) include: headaches, fatigue, transient blurring of vision, nausea, malignant hyperthermia in some individuals, hypotension, hepatotoxicity, and a

slight increase in risk for miscarriages at acute doses. To date, studies do not show that chronic exposure to isoflurane is carcinogenic. However, anesthetic gas use is frequent and prevalent at NIH. There are over 800 anesthetic gas systems at the Bethesda campus, alone. Therefore, NIH has elected to apply ALARA when possible and uphold the limits listed in Table 4.0, to more thoroughly protect all of its employees and patients, including sensitive/vulnerable populations.

Periodically (at least annually but also upon changes to OSHA, NIOSH, or ACGIH levels), the DOHS reviews the worker Occupational Exposure Limits (OELs) for anesthetic gases commonly in use at NIH. The most recent review for the NIH-Set OEL for WAG was December 22nd, 2020. The table below contains the current NIH-Set OELs, which are 8-hour time weighted averages (TWAs):

2.2 Scope and Applicability

Federal Employees

The NIH WAG Surveillance Program applies to all Federal Employees at NIH as well as to NIH owned and leased facilities, where anesthetic gases are used. The ORS Technical Assistance Branch (TAB) provides administrative management for the NIH WAG Surveillance Program and conducts leak tests and surveys for WAG.

Contractors

Contractors overseeing employees not covered by the NIH WAG Surveillance Program, but expected to work with anesthetic gases, shall develop measures that provide their workers with WAG protection keeping exposure at or under the values found in Table 4.0 of this document. Documentation of measures taken to eliminate, reduce, or mitigate known sources of WAG exposure shall be available upon request and submitted to the appropriate Project Officer prior to employees initiating work involving anesthetic gases. Proof of a WAG worker protection program must include records of representative air samples utilizing approved methods, for all locations unable to eliminate WAG exposure. Air samples need to occur during mock-ups of the highest anesthetic gas exposure risk portions of procedures and should utilize the anesthetic gas that will be used. Periodic re-sampling of WAG will be conducted using a risk-based approach for active work areas and for each employee. Sampling via Similar Exposure Groups (SEGs) is valid in lieu of sampling every individual so long as the SEGs are well defined and documented. Exposure to WAG may not exceed the NIH-Set OELs.

Mixed Groups

Areas where both contractors and Federal Employees may potentially be exposed to anesthetic gases shall follow the more employee-protective program (either the contractor's or NIH's). As schedule allows, DOHS may provide (upon request) WAG leak tests for areas that contain a mix of Federal Employees and contractors. Prior to starting work, responsible party needs to let their Project Officer (PO) know if they need DOHS to provide leak tests. The PO will then contact DOHS to schedule an appointment.

See Table 4.0: NIH-Set OELs for acceptable levels of anesthetic gases.

3.0 ROLES AND RESPONSIBILTIES

It is the organization's/IC's responsibility to repair or replace broken or faulty WAG equipment and to remove equipment from service if it is leaking. However, it is the individual's responsibility to review labeling on WAG machinery to ensure they are not inadvertently using failed WAG equipment. WAG equipment that fails its leak test or survey must not be used until repaired or replaced. Using failed WAG equipment significantly increases exposure to WAG and is likely to incur negative health consequences.

3.1 Supervisor

The supervisor is critical to a healthy safety culture. They shall have at minimum, knowledge of the health hazards of employee overexposure to anesthetic gases. The supervisor shall ensure that the employees they oversee are aware of the hazards they may be exposed to, and that the employees have access to WAG scavenging equipment appropriate for the WAG output. This knowledge list includes:

a. Short term symptoms for anesthetic gas overexposure (dizziness, headaches, fatigue, nausea, and temporary blurring of vision)
b. Chronic/Long-Term health consequences for overexposure (headaches, fatigue, nausea, in some individuals malignant hyperthermia, hypotension, hepatotoxicity, slight increase in miscarriages, but not cancer)
c. Best practices applicable to the processes/procedures utilized at their facility; mitigation methods for WAG
d. Emergency procedures for spills
e. Limitations of equipment (wear and tear/change out rates of charcoal canisters, gaskets, tubing, parafilm, etc.)
f. What sensitive/vulnerable populations for WAG are (Pregnant Workers, employees sensitized to anesthetic gases, individuals whose breathing zones are near or under fume hood sash heights, etc.)
g. Frequency of WAG leak tests are, when the next leak test for their vaporizer(s) are due,
h. The NIH-Set OEL for WAG that they are using (Table 4.0: NIH-Set OELs in Section 1 of this document)
i. What ALARA is and why it is applied for WAG
j. Any additional information needed to make an appropriate determination of whether or not the equipment and environment are adequate for the protection of their employees
k. Ensure that employees experiencing symptoms from WAG stop work and get to medical help; for severe symptoms, dial 911. For less severe symptoms, the employee must get to OMS.

Supervisors are responsible for ensuring:

a. Their employees understand the hazards posed by WAG and why ALARA is used
b. Their employees follow safe work practices when handling WAG
c. Their employees understand the limitations of their WAG system(s) and encourage a questioning outlook for equipment and systems; if something appears odd or wrong, do not trust, verify.
d. Their employees know what factors are likely to cause WAG leaks, how to check for them, and avoid them

e. Their employees have adequate safety funding to maintain WAG equipment and the knowledge to do so, or that the WAG equipment is periodically serviced/maintained by an external company
f. Their employees do not use/put-back-into-service faulty/leaking/broken WAG equipment, and individuals do not remove the WAG Alert-Tag sticker (see the top of this section) prior to TAB conducting a re-evaluation of the WAG system and flagging it as "passed"
g. Their employees know how to get a hold of DOHS should any problems or questions arise concerning WAG. DOHS Main Line: (301) 496-3457
h. Their employees are supported and encouraged to report any WAG issues.
i. DOHS TAB's WAG Program Manager is made aware of any issues with WAG or any requests individuals have for a WAG Leak Test or Survey
j. DOHS TAB's WAG Program Manager is notified when vaporizers are decommissioned (helps keep the DOHS database for WAG updated)
k. DOHS TAB's WAG Program Manager is notified when new vaporizers are installed, prior to use of the vaporizer; enough time must be given for the vaporizer to pass a Leak Test prior to its use
l. Vaporizers get re-tested before the end of their expiration month (per their DOHS WAG tag)
m. Coordination with the employee, DOHS, and as needed, OMS, to enact appropriate measures for the protection of their employees' health and safety.
n. Ensure that all incidents involving WAG are investigated as soon as possible and that corrective actions (including review and modification of risk assessment and SOPs) are implemented to prevent recurrences.

If the supervisor is unfamiliar with this information or has any questions, the WAG Program Manager (WAG PM) will go over all questions and information pertaining to the WAG program.

3.2 Employee

All employees using WAG shall have working-level knowledge of the hazards of working with anesthetic gases.

The employee is responsible for:

a. Understanding the hazards posed by WAG and why ALARA is used
b. Following and encouraging safe work practices at their workplace when handling WAG, including those recommended by the manufacturer
c. Understanding the limitations of their WAG system(s) and have a questioning attitude for equipment and systems; if something appears odd or wrong, do not trust, pause work and verify. Never assume that all items are in their correct configurations or that all connections are sealed
b. Knowing what factors are likely to cause WAG leaks, how to check for them, and avoid them
c. Maintaining WAG equipment and ensuring they have appropriate knowledge and tools to do so, or making the Supervisor aware that they are unable to maintain the WAG equipment, and that external company is needed for the task

d. NOT using or putting-back-into-service faulty/leaking/broken WAG equipment (remove faulty equipment from system and put into a locked-out configuration if at all possible)
e. NOT removing the WAG Alert-Tag sticker (see the top of this section) prior to TAB conducting a re-evaluation of the WAG system
f. Knowing how to get a hold of DOHS should any problems or questions arise concerning WAG. DOHS Main Line: (301) 496-3457
g. Notifying the DOHS TAB Program Manager and their supervisor of any health issues or circumstances that may make that individual especially sensitive/vulnerable to WAG
h. Notifying the DOHS TAB Program Manager if they need a WAG Leak Test or Survey
i. Notifying the DOHS TAB WAG Program Manager of decommissioning, disposal, or removal of WAG vaporizers and installation of new vaporizers
j. Ensuring vaporizers get re-tested before the end of their expiration month (per their DOHS WAG Tag) by contacting DOHS and showing up for the survey or leak test
k. If feeling unwell due to a likely WAG overexposure, the employee should visit OMS if possible so that OMS may administer aid for the symptoms and update health records. OMS may be reached at (301) 496-4411 and is on the 6th floor of Building 10 6C306. If the individual is too unwell to reach OMS, get them out of harm's way, and then call OMS for further assistance. If it is a medical emergency, dial 911.
l. If employees have questions about WAG, they should first consult the NIH WAG Program Document or the WAG fact sheet, then check with their supervisors if something remains unclear.
m. Immediately stop work and notify supervisor if there are any changes to procedures or deficiencies in the work process or risk assessment.
n. Ensure that risks are eliminated or minimized as far as reasonably achievable (ALARA).
o. Provide assistance with the risk assessment process to ensure the assessment is comprehensive and accurate.
p. Follow safe operating procedures using the controls outlined in the risk assessment.
q. Wear all PPE required and ensure it is maintained in good condition.

3.3 Safety Specialist

Institute or Center (IC) Safety Specialists periodically conduct walk-through safety surveys. If WAG vaporizers are discovered, please notify the WAG PM with the following information:

I. Vaporizer Serial Number (manufacturer)
II. Location
III. Point of Contact/Responsible Individual for that vaporizer
IV. POC's email and phone
V. What IC is responsible for the vaporizer or space
VI. Any special/extenuating circumstances that prioritizes a particular case over others. Example: hypersensitive/vulnerable population(s), immediate health or safety risk, lab-wide or large-area disturbance due to WAG leak, WAG levels high enough to detect by scent (varies with individuals, 50ppm-2,000ppm) etc.

3.4 WAG Program Manager

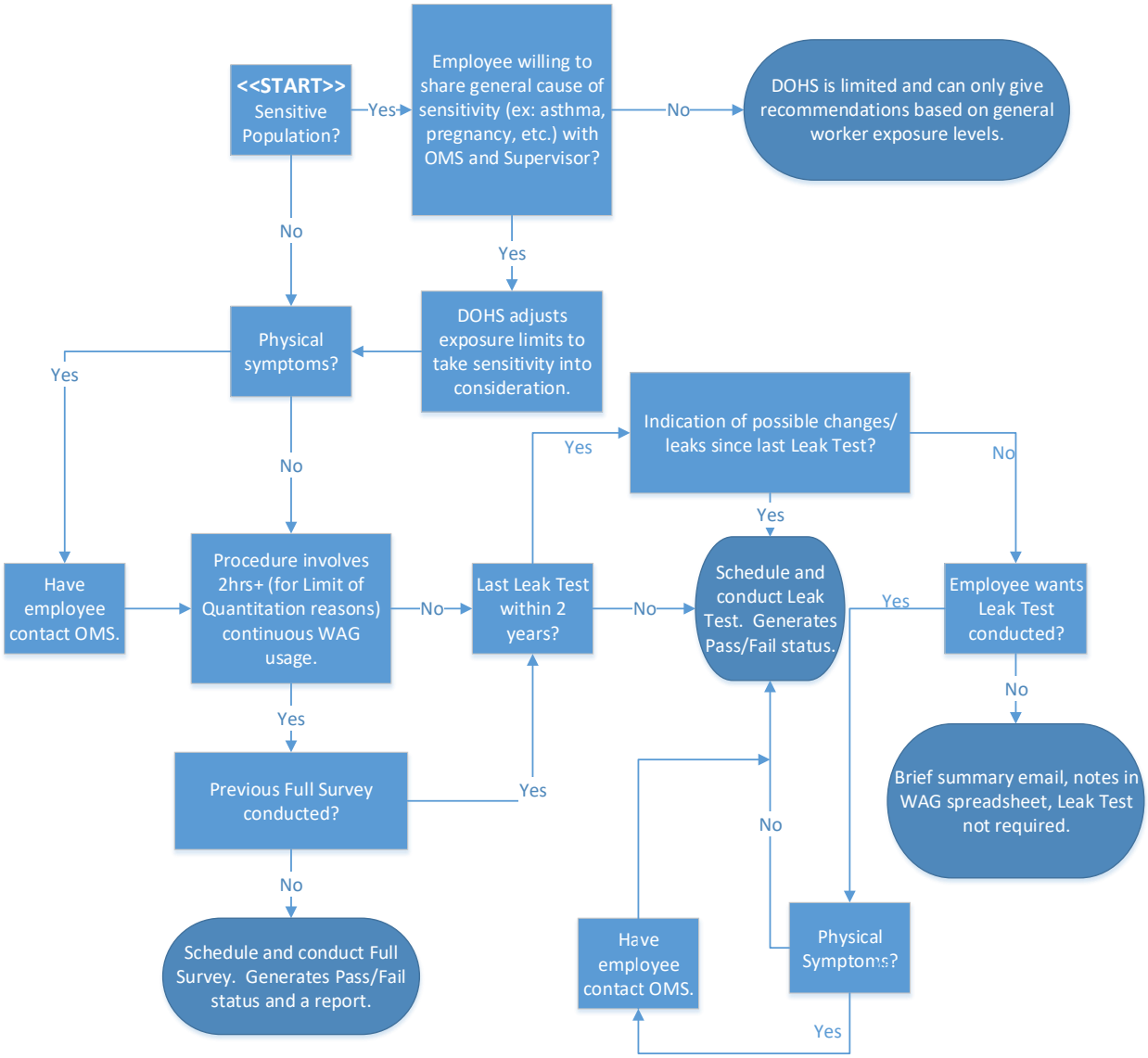
The WAG PM is responsible for:

a. Evaluating and adjusting the OELs for WAG, as peer-reviewed scientific literature becomes available on the subject, emphasizing protection of the employee as the primary deciding factor,
b. Evaluating industry best practices and current equipment for WAG as they become available,
c. Communicate with SOSB on the WAG Program at least annually; more frequently if requested to; presentation,
d. Ensure NIH satellite sites also have recent WAG Program information and updates as appropriate. Offer training if they would like it,
e. Determining and publishing the bi-annual schedule of WAG leak tests and surveys,
f. Coordinating between groups, individuals, and labs, to ensure leak tests and surveys occur in a timely manner,
g. Updating WAG-related items/templates: WAG Training Presentation, WAG fact sheet(s), WAG Leak Test forms, WAG Alert- tags, WAG pass/fail tags, etc.
h. Ensuring equipment used for WAG surveys and leak tests are calibrated, bump tested, and functional. Ensure supplies for WAG equipment are available (batteries, calibration gas, etc.) Ensure samples for WAG are tracked and sent out in a timely manner,
i. Ensuring results from WAG Leak Tests are made clear for those impacted,
j. Providing advice upon request, or when there is an active health risk, on how to improve or fix WAG scavenging systems,
k. Develop, teach, and improve upon the WAG Training.
l. Providing information to DOHS for updates to the WAG website,
m. Providing all WAG-related policy changes to OMS as they arise,
n. Meeting with OMS at least quarterly to see if there are trends,
o. Offering emergency WAG leak tests within 2 Business Days if hyper-sensitized populations are involved. In the meantime, workers should pause work if they suspect a WAG leak.
p. At least annually, and preferably quarterly, review and improve upon the WAG Program and its components.
q. Ensuring critical information about WAG survey locations is communicated clearly. Example: "This location recently had an accidental small contained fire that involved the fumehood where the WAG vaporizer is normally used. The Fire Department has given the all-clear for O2 levels, H2S, CO, and LEL, but exact chemicals that combusted are still being investigated. Recommend half face respirators with chemical cartridges prior to entry for the survey, or to not allow re-start of work or conducting a survey until three days hence, when the air change should have removed the majority of chemical contaminants from the area. Proceed with caution."

Mastery of the following information:

a. Short term symptoms for anesthetic gas overexposure (dizziness, headaches, fatigue, nausea, and temporary blurring of vision)

b. Chronic/Long-Term health consequences for overexposure (headaches, fatigue, nausea, in some individuals malignant hyperthermia, hypotension, hepatotoxicity, slight increase in miscarriages, but not cancer)
c. Mitigation methods for WAG
d. Limitations of equipment
e. What sensitive/vulnerable populations for WAG are (Pregnant Workers, employees sensitized to anesthetic gases, individuals whose breathing zones are near or under fumehood sash heights, etc.)
f. Frequency of WAG leak tests
g. The NIH-OEL for WAG
h. What ALARA is and why it is applied for WAG
i. Industrial Hygiene in general; be able to completely explain why the sampling method used was the one selected above all others, what the results mean, what limitations of the equipment and circumstances are, what the options going forward are, the pros and cons of available options, and provide recommendations and solutions to completely remove employee exposures or reduce exposures below NIH-Set OELs.


<<START>> Sensitive Population?
Yes
Employee willing to share general cause of sensitivity (ex: asthma, pregnancy, etc.) with OMS and Supervisor?
No
DOHS is limited and can only give recommendations based on general worker exposure levels.
No
Yes
DOHS adjusts exposure limits to take sensitivity into consideration.
Physical symptoms?
Yes
No
Have employee contact OMS.
Procedure involves 2hrs+ (for Limit of Quantitation reasons) continuous WAG usage.
No
Last Leak Test within 2 years?
Yes
Indication of possible changes/ leaks since last Leak Test?
No
Yes
Schedule and conduct Leak Test. Generates Pass/Fail status.
No
Yes
Employee wants Leak Test conducted?
No
Brief summary email, notes in WAG spreadsheet, Leak Test not required.
Yes
Previous Full Survey conducted?
Yes
No
Schedule and conduct Full Survey. Generates Pass/Fail status and a report.
Have employee contact OMS.
Physical Symptoms?
No
Yes

4.0EXPOSURE LIMITS (UPDATED 12/22/2020)

Table 4.0: NIH Occupational Exposure Levels

Anesthetic Gas	NIH-Set OEL as a TWA in parts per million (ppm)	Addtl. Notes
Isoflurane/Forane (C3H2ClF5O)	**2.0** ppm (based on CalOSHA, NIOSH, and ALARA)	Effects on pregnancy under study. Additionally, the 2021 TLV indicates a Notice of Intended Change for isoflurane.
Enflurane (C3H2ClF5O)	**75.0** ppm (based on ACGIH)	FDA Pregnancy Risk Group C
Desflurane (C3H2F6O)	**2.0** ppm (Set similar to Iso and Sevo; similar health impacts)	Effects on pregnancy under study.
Halothane (C2HBrClF3)	Replace with safer anesthetic gas where possible. **2** ppm TWA otherwise (NIOSH REL)	Liver damage.
Nitrous oxide (N2O)	**25.0** ppm (NIOSH REL)	Prolonged exposure may inhibit DNA synthesis; avoid in the first trimester.
Sevoflurane (C4H3F7O)	**2.0** ppm (NIOSH REL)	Effects on pregnancy under study.

ACGIH, NIOSH, FDA, and CalOSHA for TWAs. *Continuing Education in Anesthesia in Critical Care & Pain* for details for exposure impacts on pregnancy.

Halothane:
NIOSH REL
2 ppm (16.2 mg/m3) [60-minute] [*Note: REL for exposure to waste anesthetic gas.]

OSHA PEL
None

Nitrous Oxide:
NIOSH REL
TWA 25 ppm (46 mg/m3) (TWA over the time exposed) [*Note: REL for exposure to waste anesthetic gas.]

OSHA PEL
None

4.1 Requests for Exemption

Requests for exemptions must be sent to the TAB Branch Chief in writing, with the following information and any other information the TAB Branch Chief requests, for making the determination.

Name:
Date:
IC:
Contact information:
Work being conducted that involves WAG:
Levels of WAG present:
Why additional control measures do not work:

5.0 PROGRAM ELEMENTS

5.1 Exposure Monitoring

5.1.1 Identification of Exposed Employees

Supervisors are responsible for notifying the WAG Program Manager of any NIH employees who may potentially be exposed to WAG. Either the supervisor or their designee will forward the contact information for a Point of Contact, to the WAG Program Manager.

The following basic information will be asked for:
Point of Contact:
Preferred method to contact the POC: (Email, phone, pager)
Serial # of Vaporizer:
Type of anesthetic used:
Dates and times preferred:
Known hazards: (ex: Monkeys in the location may reach between bars and scratch during survey)
Access processes: (ex: Card access only; will need to page for escort)

The WAG Program Manager or their representative will make appointment times available for scheduling a WAG leak test or full survey, depending on the risk and information available about the location. The WAG Program Manager or or their representative will keep track of locations that have WAG vaporizers and the status of those; passed or failed, for leak tests/full surveys.

5.1.2 Initial Monitoring

Full surveys are generally utilized when there is likely a spike in WAG levels that is not easily measurable via direct reading instrument, when a WAG scavenging system is first being set up, when sensitive/vulnerable populations are at risk, or upon request.

In areas where it has been determined that a potential WAG exposure may exist, employees will be monitored to determine their exposure to WAG relative to the NIH-OEL. Employee monitoring will be extrapolated to represent other employees performing the identical job task in the same laboratory.

The leak test process shall be repeated each time there is a change in process, equipment, or control measures which may result in new or additional exposure to WAG, or every two years, whichever comes first.

5.1.3 Exceptions on Monitoring

In lieu of monitoring, an objective assessment may be performed to determine the exposure. This assessment may include a review of data on similar exposure groups (SEGs), as per those workers that have a similar exposure profile and job classification. Specifically, similar job tasks that have been previously monitored through integrated sampling (covering the entire period of exposure) could be reviewed and used as a representative comparison. When objective data is used, the employee's name and ID number, job task, and the Industrial Hygienist's (IH) reasoning for exempting the employee from monitoring will be documented. Original copies of the exemption form will be kept by DOHS.

5.1.4 Employee Complaint of WAG Exposure

An employee health complaint related to WAG exposure, e.g., symptoms of dizziness, blurred vision, headaches, difficulty concentrating, etc. will initiate personal monitoring of that employee and background monitoring of the job task. Monitoring of employees reporting signs or symptoms will be done promptly. Work should be paused if there are odor complaints of isoflurane, as the odor threshold for isoflurane far exceeds the NIH-OEL. Monitoring will be conducted in response to odor complaints that can be linked to WAG.

5.2 Equipment and Methodology

Equipment used for NIH's WAG Leak Tests and Surveys fall into two general categories: direct reading instruments and passive dosimeters. The Industrial Hygienist (IH) conducting the leak test or survey will determine the best method for identifying and stopping a WAG leak. Information regarding equipment utilized is available upon request. Additionally, the schedule for WAG surveys and leak tests is available in S Drive

Direct reading instruments:

Direct reading instruments sample the air in an area and provide either numerical data or an alert if WAG is above a preset level.

Passive Dosimeters:

Valid for procedures lasting at least 2-hours, due to Limit of Quantitation issues. OSHA Method 103. Passive dosimeters are acceptable to use for isoflurane, enflurane, and halothane.

5.3 Leak Tests and Full Surveys

Leak Tests:

Leak tests use direct reading instruments only and pinpoint locations of leaks. The IH will then work with the personnel in charge of the vaporizer to fix the leak as soon as possible; usually prior to the end of the visit. The IH conducting the Leak Test will discuss with the POC about the processes and procedures that regularly take place, prior to sampling. Leak Tests shall always be conducted in a manner that simulates periods of a procedure most likely to cause the highest exposures.

Passed leak tests result in a "Pass" circle on the WAG sticker and a brief email to the POC, noting that the location passed.

Failed leak tests result in the IH staying on-site and attempting to fix the leak, if possible. If the leak cannot be fixed, then the IH will place an Alert-Tag on the faulty equipment. Additionally, the IH will circle the word "Failed" on the primary WAG Equipment Sticker (*See "Attachment 3,\ WAG Stickers"*) to ensure visibility. Please note that this equipment is not to be used until the components that failed have been fixed or replaced *and* a follow-up leak test has been conducted on the equipment, and the equipment passes. Additionally, for all failed WAG leak tests, an email will be sent from the IH to the POC explaining the issue and all recommendations.

Full Survey:

Full Surveys are an option conducted when a procedure exceeds 2 hours and there is a WAG leak that is not easily correctable, or when the procedure doesn't lend itself towards being measured by a direct reading instrument (MRI room, for example). Full Surveys involve passive dosimeters and may or may not involve direct reading instruments. Dosimeters are placed in a few key areas, at a minimum: breathing zone of primary employee being monitored, breathing zone of an employee within a similar exposure group, near the vaporizer, near the anesthesiologists/physicians, and at least one field blank. Additional dosimeters may be placed at the IH's discretion. A full survey report will be provided to the POC.

5.4 How to schedule a Leak Test or Survey

The frequency of leak tests and surveys is at least one leak test or full survey per two years. The type conducted depends on the location. Currently, at a minimum, leak tests have been conducted on WAG systems. Full surveys are used for locations with higher risk, and are being phased in.

Leak tests and surveys can be scheduled by calling the **DOHS main line at (301) 496-3457.** The leak tests and surveys are provided for free, to NIH locations.

If equipment was disassembled and reassembled, newly installed, never leak tested/surveyed, or there is a sensitive or vulnerable population, or possible WAG leak, a leak test or survey is recommended.

5.5 Emergency Response:

Place work in safe configuration, clear the space, if symptoms persist contact OMS.

5.5.1 Acute Exposure Symptoms

If symptoms are severe, get out of the area, call 911, and follow their instructions.

Severe overexposure symptoms:

Severe headache, blurring of vision, nausea, difficulty focusing or thinking, malignant hyperthermia in some individuals, hypotension, hepatotoxicity.

- Small amounts of isoflurane on skin or clothing will evaporate quickly, but remove excess isoflurane from the individual by flushing with water. Remove the employee affected by isoflurane to an area with fresh, uncontaminated air.
- If the employee is unconsciousness, stay with that person and continue to monitor signs and symptoms. Call for help.

5.5.2 Mild Symptoms, Large Spill

(equal to or greater than 50ml, or if uncertain on quantity or potential hazards):

1. ***Immediately discontinue usage of anesthetic gases*** in that system until sufficient WAG removal can occur. This occurs over time through air changes.
2. Put equipment in a safe, "off" configuration. Get the effected individual to fresh air. Help the individual document symptoms if possible; it's easier to gather information nearer the event than recalling afterwards.
3. Get the employee to your facility's medical services (OMS) as soon as possible; bring the list of symptoms and provide those to OMS.
4. Call the Fire Department and let them know about the spill. **NIH Fire Department: (301) 496-2372**
5. Let DOHS know about the spill, so they can provide assistance as needed. **DOHS main line at (301) 496-3457.**
6. Prevent other employees from entering the area

5.5.3 Mild Symptoms, Small Spill

(less than 50ml, and if Lab Procedures allow and all other hazards are known and controlled):

1. ***Immediately discontinue usage of anesthetic gases*** in that system until sufficient WAG removal can occur. This occurs over time through air changes.
2. Put equipment in a safe, "off" configuration. Get the effected individual to fresh air. Help the individual document symptoms if possible; it's easier to gather information nearer the event than recalling afterwards.
3. Get the employee to your facility's medical services (OMS) as soon as possible; bring the list of symptoms and provide those to OMS.
4. Increase ventilation in room.
5. Use protective gloves to avoid skin contact and if the lab protocol allows, clean up remaining liquid using absorptive material.
6. Dispose of material as waste through NIH Chemical Waste; call for pick-up.
    - **Chemical Waste Pick-Up: (301) 496-4710**
    - **Chemical Waste Help: (301) 496-7990**
7. Prevent other employees not directly responsible for clean-up, from entering the area.
8. Let DOHS know about the spill, so they can provide assistance as needed. **DOHS main line at (301) 496-3457.**

It is the employee and their supervisor's responsibility to stop work and get the employee to OMS, should such symptoms arise. OMS documents the chronic and acute symptoms, addresses the symptoms, and makes recommendations on any further medical care or monitoring needed for

recovery. The medical services facility provides medical evaluations to determine an individual's health status and have highly qualified medically trained physicians, physician's assistants, and nurses. Over time, a small percentage of the population using anesthetic gases develops hypersensitivity and side-effects such as headaches and nausea may occur where previously they did not. This presents a serious hazard for the employee as well as for the patient or animal they are working with.

Re-entry:
If the accident involving WAG included other chemicals, physical hazards such as fire, or low oxygen levels, please contact the **NIH Fire Department** for an all-clear prior to re-entry.

After the all-clear from the NIH Fire Department (if applicable) and prior to using WAG equipment after an accident, please schedule a full survey to ensure the system is still functioning sufficiently for the protection of employees; please make sure DOHS notes that it was post-accident so the TAB staff is aware and has information for their pre-job hazard briefing. **DOHS main line: (301) 496-3457**

6.0 EMPLOYEE TRAINING

It is the responsibility of the supervisor, assisted by the IC Safety Specialist, to ensure that all employees who are assigned to workplaces where there is a potential health hazard from WAG participate in a training program, which covers WAG hazards relevant to that lab. All employees at the time of their initial assignment and whenever a new hazard from WAG is introduced into their area, shall be provided with information and training on WAG. The training shall be repeated at least annually.

As an additional training component, the TAB may provide the WAG Fact Sheet (See Attachment 1). It is the supervisor's responsibility to make sure the employee reads through the provided information.

7.0 INTERNAL REVIEW

The internal review is to serve as a check-list of things that the Program Manager should consider, when updating this program document and its associated program. The Program Manager can add or remove items from the list as deemed appropriate, but the reasoning to remove an item must be documented.

1. Are all the sections in a coherent, easy-to-follow format?
2. Is the document flow acceptable?
3. Are there terms or definitions that need to be added or further clarified?
4. Is the OEL up to date with current regulatory or industry-best-practices?
5. Have all of the comments gathered throughout the year been addressed in the comment resolution matrix?
6. Have all of the TAB director's comments been thoroughly addressed to the satisfaction of both parties?

7. Has at least one CIH not directly responsible for the program document reviewed this document for technical strength, and have those comments been resolved or added?
8. Have comments from clients, questions, etc. been addressed by this document?
9. If there is a template for TAB programs, does this follow it fairly closely?

8.0 REFERENCES

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Mazze RI, Fujinaga M, Rice SA, et al. *Reproductive and teratogenic effects of nitrous oxide, halothane, isoflurane, and enflurane in Sprague-Dawley rats. Anesthesiology 1986; 64: 339–44*

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What is waste anesthetic gas (WAG)?

Waste anesthetic gas, or WAG, is a term commonly used in relation to the occupational (worker) exposure of anesthetic gas during a medical or surgical procedure. Elements that contribute to WAG include:

- Leakage from tubing, seals and gaskets
- Work practices/lack of training
- Poor ventilation
- Ineffective gas scavenging systems
- Not weighing and changing out charcoal canisters per manufacturer's recommendations

What are the health effects of being exposed to WAG ?

Studies on newer anesthetics such as isoflurane have shown increased irritability, headaches, fatigue, delayed reaction times, CNS impact, and miscarriages in mice exposed to acute doses. Therefore, attempts should be made to minimize occupational exposure to WAG.

Common WAG leak sources.

Are there any DOHS programs in relation to WAG ?

The DOHS has established a written WAG Surveillance Program, which primarily entails performing surveys and leak tests to quantify exposure levels and provide recommendations to reduce exposure. A survey or leak test may include: monitoring employees for exposure, performing a leak test of the anesthetic breathing circuit, and providing recommendations to further reduce any potential exposure.

A copy of the current WAG Surveillance Program is posted on the DOHS website: https://www.ors.od.nih.gov/sr/dohs/safety/laboratory/Pages/gas_surveillance.aspx#Waste

Does DOHS perform a survey or leak test at all locations?

DOHS recognizes that it may be infeasible (e.g. unscheduled procedures, infrequent use) to perform a survey or leak test at every location throughout NIH that utilizes anesthetic gas for a procedure. WAG Surveillance Program efforts are focused where there is a greater risk for potential exposure to WAG (active surgical suites, high duration of procedures, etc.).

A survey or leak test may be requested by contacting DOHS at **(301) 496-3457**.

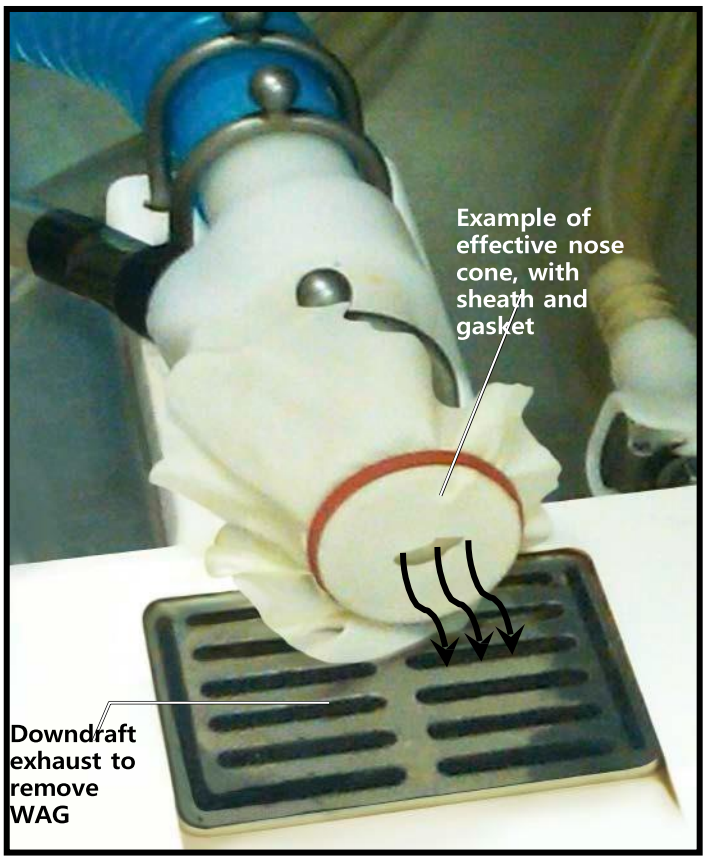
NIH Division of Occupational Health and Safety (DOHS)
Technical Assistance Branch (TAB)
Building 13, Room 3K04
301-496-3457
09/2017

Consider posting this Fact Sheet & Checklist in the work area, and perform the following checks each time anesthetic gas is administered:

- ☐ Ensure personnel have received the appropriate documented training on how to use the equipment.
- ☐ Review and understand the manufacturer's instructions for operating the equipment.
- ☐ Ensure induction chamber lids are closed and locked when anesthetic gas is being delivered.
- ☐ Inspect lid gaskets to ensure they have a tight seal to the induction chamber. Replace defective gaskets.
- ☐ Ensure all connections are properly secure.
- ☐ Inspect tubing, valves and fittings for leaks. Seal all leaks.
- ☐ Use the flushing/purge system (if applicable) to flush for 5-10 seconds, or the time period noted by the manufacturer.
- ☐ Use a certified local exhaust ventilation system (chemical fumehood, downdraft table/sink, etc.) as the preferred means to remove WAG. A biosafety cabinet that is NOT ducted to the exhaust system is not sufficient. WAG will simply recirculate in the room.
- ☐ Maintain downdraft tables free of obstructions.
- ☐ Avoid excessive flow rates.
- ☐ Ensure the ports are sealed/plugged if animals are not in place (when using manifold or multi-port systems, including some imaging units).
- ☐ Use a certified local exhaust ventilation system (chemical fume hood, downdraft table/sink, etc.) when filling the vaporizer.
- ☐ Keep laboratory doors closed when anesthetic gas is in use.
- ☐ Ensure preventative maintenance has been performed on the system annually, or more frequent if recommended by the manufacturer.
- ☐ Create a nose cone for small animals (if applicable) comprised of a sheath and gasket to minimize WAG from escaping around an animal's face (see photo).

Small charcoal canisters:

- ☐ Adhere to the weighing and change-out schedules, as recommended by the manufacturer for the commonly used small charcoal canisters (e.g. F/AIR canisters).
- ☐ Weigh the canisters before every use.
- ☐ Avoid the use of any other large charcoal based scavenging systems, as per guidance from the NIH "Ductless Fume Hood Review" document.



Learn More About The WAG Program

If you have questions about WAG leaks, contact NIH DOHS at (301) 496-3457.

Attachment 2: WAG Leak Test Form

Appointment Date: Click here to enter a date.
Appointment Time: Click here to enter text.
Campus: Click here to enter text.
Building: Click here to enter text.
Room: Click here to enter text.
Main Point of Contact (POC): Click here to enter text.
POC Phone Number: Click here to enter text.
Additional POC(s): Click here to enter text.
Additional POC(s): Click here to enter text.
Institute: Click here to enter text.

2021 Waste Anesthetic Gas (WAG) Leak Test

Fields on this form are **not mandatory**; this form serves to organize data collection and to function as a checklist. Data must adequately describe vaporizer leak/no-leak status, the location(s), and the POC(s) of vaporizer(s). Email or verbal explanation of the results are sufficient for locations that pass. For locations that failed, all follow-up appointments must be initiated by the responsible IC/Lab/PI, etc. after remedies are applied, and continue after fixes are implemented, until results from the areas are at or below 2 parts per million (ppm) time weighted average (TWA).

If there are sensitive/vulnerable populations (pregnant women, individuals with known adverse responses to anesthetic gas, individuals with heart conditions, asthma, etc.), please consider contacting the Office of Research Services, Division of Occupational Health and Safety (DOHS) for a more thorough review of the workspace, as some of the legal or recommended limits for chemical, physical and biological hazards are lower for those individuals compared to the general population.

SENSITIVE/VULNERABLE POPULATION?: Yes ☐ No ☐ This includes things such as pregnancy, immunocompromised individuals, asthma, etc. Basically, are there special considerations for this particular set of individuals that may change the appropriate occupational exposure levels? If yes, mark identify the appropriate allowable exposure levels below. Indicate those levels in all final reports and conclusion emails. Identify the special consideration by type of sensitivity and impact to OELs, **not** by individual.

DOHS strongly recommends against using equipment that is leaking past 2ppm TWA for isoflurane, desflurane, and sevolflurane.

Table 1.0: NIH-Set Occupational Exposure Limits

Anesthetic Gas	NIH-Set OEL as a TWA in parts per million (ppm)	Addtl. Notes
Isoflurane/Forane (C3H2ClF5O)	**2.0** ppm (based on CalOSHA, NIOSH, and ALARA)	Effects on pregnancy under study.
Enflurane (C3H2ClF5O)	**75.0** ppm (based on ACGIH)	FDA Pregnancy Risk Group C
Desflurane (C3H2F6O)	**2.0** ppm (Set similar to Iso and Sevo; similar health impacts)	Effects on pregnancy under study.
Halothane (C2HBrClF3)	Replace with safer anesthetic gas where possible. **2** ppm TWA otherwise (NIOSH REL)	Liver damage.

Nitrous oxide (N2O)	**25.0** ppm (NIOSH REL)	Prolonged exposure may inhibit DNA synthesis; avoid in the first trimester.
Sevoflurane (C4H3F7O)	**2.0** ppm (NIOSH REL)	Effects on pregnancy under study.

PASS/FAIL: Pass ☐ Fail ☐ *"PASS" means the TWA≤2ppm. "FAIL" means the TWA ≥ Table 1.0.*

N2O USED?: Yes ☐ No ☐ Is nitrous oxide used either on its own or with other gases?

ORIGINAL REASON FOR LEAK TEST/SURVEY: Click here to enter text.

FUTURE ASSESSOR ACCESSIBLITY NOTES: *(Ex: Can someone have previously been in another animal facility prior to this one? Is there only one ramp entrance at the fare side of the building? Is there no entry allowed without a POC in the lobby?)*
Click here to enter text.
MANUFACTURER SERIAL NUMBER(S) OF MACHINE: Click here to enter text.
DOHS NUMBER(S) [PURPLE AND SILVER STICKER]: Click here to enter text.
MANUFACTURER: Click here to enter text.
MAKE/MODEL: Click here to enter text.
DATE OF NEXT DOHS LEAK TEST/SURVEY: Click here to enter text.

CONDITIONAL PASS LIMITATIONS: *If there are specific conditions (fume hood must be on, for example) for the setup passing.*
Click here to enter text.

IF VAPORIZER SYSTEM FAILED: *Only fill out the two questions below if the vaporizer system failed.*
CAN EQUIPMENT STILL BE USED? ☐Yes ☐No
NEXT APPOINTMENT DATE: Click here to enter a date.

EXTENSION UNTIL: *If the next required leak test exceeds two years in the future.*
REASON: Click here to enter text.

PROCEDURE:
☐MOUSE ☐RAT ☐PIG
☐PATIENT ☐NON-HUMAN PRIMATE ☐OTHER: Click here to enter text.

VAPORIZER GAS TYPE:
☐ISOFLURANE ☐DESFLURANE ☐SEVOFLURANE
☐HALOTHANE ☐OTHER: Click here to enter text.

FLOWRATE (LITERS/MIN): Click here to enter text. **% CONCENTRATION:** Click here to enter text.

TASK/NORMAL OPERATION BRIEF DESCRIPTION:
Click here to enter text.

ENGINEERING CONTROLS:
Use check boxes and take notes. Record whether or not there was any kind of exposure-mitigation equipment and if that equipment was operational, on, or off during the survey.

If charcoal canister, make sure to measure at the exhausting end of the canister (has holes) and note when it was last weighed. Also ask if they weigh the canisters before each use.

☐BIOSAFETY CABINET ☐CHEMICAL FUMEHOOD ☐DOWNDRAFT TABLE

CHARCOAL CANNISTER(S): ☐LARGE ☐SMALL
CANISTER LEAKING FROM EXHAUST GAPS? ☐Yes ☐No
CANISTER LAST WEIGHED: Click here to enter text.
EXHAUSTED FROM LAB? ☐Yes ☐No
LOCAL EXHAUST VENTILATION (Other): Click here to enter text.
AIRFLOW NEGATIVE TO PROCEDURE ROOM? ☐Yes ☐No
DETERMINED HOW? Click here to enter text.

ROOM AIRFLOW: *(Approximate)*
OF INCOMING AIR VENTS: Click here to enter text.
SMALL (<1ft²): Click here to enter text.
MEDIUM (>1ft², <3ft²): Click here to enter text.
LARGE (>3ft²): Click here to enter text.

OF OUTGOING AIR VENTS: Click here to enter text.
SMALL (<1ft²): Click here to enter text.
MEDIUM (>1ft², <3ft²): Click here to enter text.
LARGE (>3ft²): Click here to enter text.

CHEMICAL INTERFERENCE(S)? ☐Yes ☐No

COMMENTS/NOTES:
Click here to enter text.

MONITORING (LEAK TEST)
For the purpose of evaluating personal exposure, the NIH occupational exposure limit for isoflurane is 2.0 parts per million (ppm), which is an 8-hour time weighted average (TWA).

Note: The direct reading exposure monitoring results will be more conservative than dosimeters as long as the highest-risk portion of the process is measured. The surveyor will take real-time measurements: 1) in the expected highest-exposure locations and 2) as much as possible, during portions of processes that actively use WAG, to help identify leaks and to arrive at protective estimates of potential exposures.

GENERAL LABORATORY AREA:
HALLWAY, LOBBY OR OUTDOORS (should be 0 ppm Isoflurane): Click here to enter text.

EQUIPMENT/DELIVERY SYSTEM:
DIRECTLY RIGHT OF THE VAPORIZER (1ST CONNECTION) Click here to enter text.
"Y" CONNECTION POINT Click here to enter text.
STOPCOCK Click here to enter text.
INDUCTION CHAMBER/LID Click here to enter text. CLOSED / ON Click here to enter text.
OPEN / ON *(Do this measurement last; it will spike probe)* Click here to enter text.

GAS INPUT PORT TO INDUCTION CHAMBER Click here to enter text.
GAS EXHAUST PORT FROM INDUCTION CHAMBER Click here to enter text.
NOSECONE(S) Click here to enter text.
ABSORPTION FILTER(S)/CHARCOAL CANISTERS *(At exhaust ports)* Click here to enter text.
OTHER(S) Click here to enter text.

CONCLUSIONS:
- Identify areas of concerns/leaks
- Compare results to previous survey, and previous leak test(s)
- Results could indicate concentration "likely" to remain below 2 ppm as an 8 hour TWA; based on readings; comparing to previous surveys/leak tests, rough calculations. If direct measurement remains under 2 ppm during observation and does not significantly increase over time, the TWA is unlikely to exceed 2 ppm; especially if personnel are exposed less than 40 hours/week and procedures remain similar.

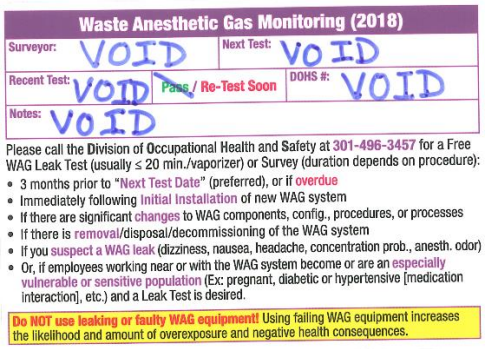
Click here to enter text.

RECOMMENDATIONS:
1. Click here to enter text.
2. Click here to enter text.
3. Click here to enter text.

PERFORMED BY: Click here to enter text. **[INDUSTRIAL HYGIENIST]** **DATE:** Click here to enter a date.

All WAG Leak Tests and Surveys are also sent to and reviewed by the NIH DOHS WAG Program Manager.

Attachment 3: WAG Stickers



Waste Anesthetic Gas Monitoring (2018)

Surveyor: VOID | Next Test: VOID

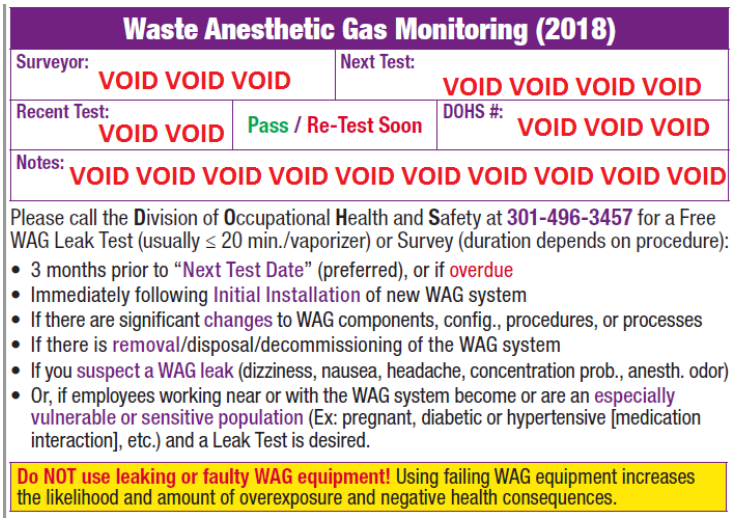
Recent Test: VOID | Pass / Re-Test Soon | DOHS #: VOID

Notes: VOID

Please call the Division of Occupational Health and Safety at 301-496-3457 for a Free WAG Leak Test (usually ≤ 20 min./vaporizer) or Survey (duration depends on procedure):

- 3 months prior to "Next Test Date" (preferred), or if overdue
- Immediately following Initial Installation of new WAG system
- If there are significant changes to WAG components, config., procedures, or processes
- If there is removal/disposal/decommissioning of the WAG system
- If you suspect a WAG leak (dizziness, nausea, headache, concentration prob., anesth. odor)
- Or, if employees working near or with the WAG system become or are an especially vulnerable or sensitive population (Ex: pregnant, diabetic or hypertensive [medication interaction], etc.) and a Leak Test is desired.

Do NOT use leaking or faulty WAG equipment! Using failing WAG equipment increases the likelihood and amount of overexposure and negative health consequences.



Waste Anesthetic Gas Monitoring (2018)

Surveyor: VOID VOID VOID | Next Test: VOID VOID VOID VOID

Recent Test: VOID VOID | Pass / Re-Test Soon | DOHS #: VOID VOID VOID

Notes: VOID VOID VOID VOID VOID VOID VOID VOID VOID VOID

Please call the Division of Occupational Health and Safety at 301-496-3457 for a Free WAG Leak Test (usually ≤ 20 min./vaporizer) or Survey (duration depends on procedure):

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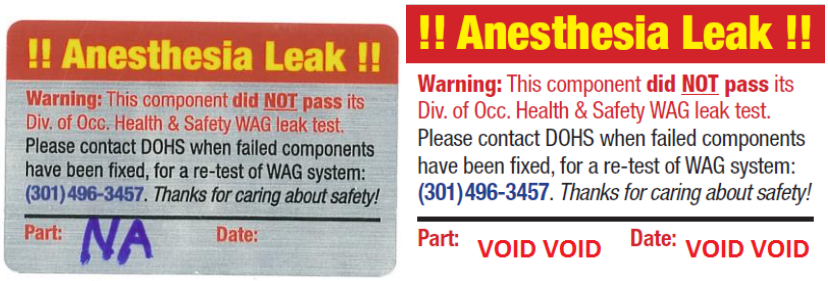
- If there is removal/disposal/decommissioning of the WAG system
- If you suspect a WAG leak (dizziness, nausea, headache, concentration prob., anesth. odor)
- Or, if employees working near or with the WAG system become or are an especially vulnerable or sensitive population (Ex: pregnant, diabetic or hypertensive [medication interaction], etc.) and a Leak Test is desired.

Do NOT use leaking or faulty WAG equipment! Using failing WAG equipment increases the likelihood and amount of overexposure and negative health consequences.

Pass/Fail WAG tag. Pass or Fail will be circled. This is an opaque sticker noting key information about the vaporizer as well as when to call DOHS for a Leak Test or survey. It also tells the user to not use failing equipment. Usually it is placed on the vaporizer itself when at all possible; if there is no space on the vaporizer for this sticker, it is placed within about a 6 inch radius of the vaporizer itself.

DOHS WAG equipment number; each vaporizer has a unique sticker number. Silver background, no red box; purple box. Pre-printed numbering.



!! Anesthesia Leak !!

Warning: This component **did NOT pass** its Div. of Occ. Health & Safety WAG leak test. Please contact DOHS when failed components have been fixed, for a re-test of WAG system: **(301) 496-3457**. *Thanks for caring about safety!*

Part: NA Date:

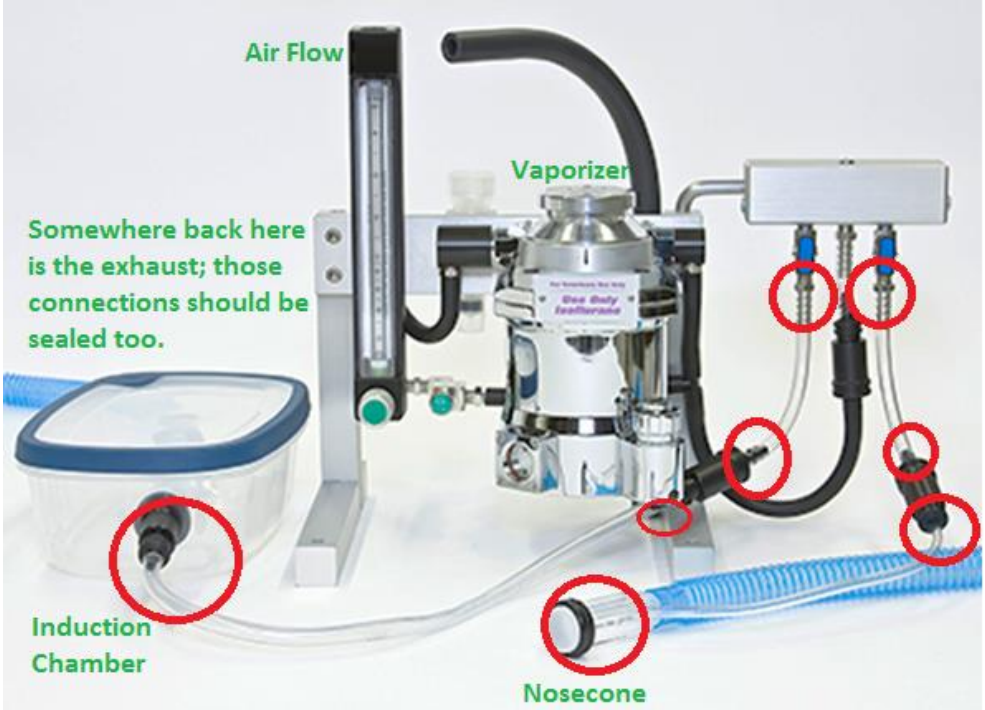
!! Anesthesia Leak !!

Warning: This component **did NOT pass** its Div. of Occ. Health & Safety WAG leak test. Please contact DOHS when failed components have been fixed, for a re-test of WAG system: **(301) 496-3457**. *Thanks for caring about safety!*

Part: VOID VOID Date: VOID VOID

Sticker with silver background used for failed components; a visual "Alert-Tag" indicator with space for the exact part that failed as well as the date that that component failed its leak test/survey. The exact text is below (format changed slightly due to trying to make it fit.) This sticker is small so that it can be tagged onto tubing easily.

Learn More About The WAG Program

If you have questions about WAG leaks, contact NIH DOHS at (301) 496-3457.

Attachment 4: Common places for WAG leaks