Status Active PolicyStat ID 12455521

Beaumont

Origination	10/25/2022
Last Approved	10/25/2022
Effective	10/25/2022
Last Revised	10/25/2022
Next Review	10/24/2025

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Area	EOC-Safety
Applicability	Beaumont All Sites

Monitoring Hazardous Gases and Vapors

Document Type: Policy

I. PURPOSE AND OBJECTIVE:

Gases that may be monitored include trace anesthesia gases, Formaldehyde, Isopropyl Alcohol, Methanol, Xylene, Ethylene Oxide, Methylene Chloride and others identified as potentially hazardous to staff.

II. POLICY STATEMENT:

It is the policy of Beaumont Health to provide a safe environment for all staff and employees. It is the intent of this policy to ensure that proper and adequate testing of air contaminants and trace anesthesia gases is performed.

III. DEFINITIONS:

A. **Action Level -** the exposure level at which Occupational Safety and Health Administration (OSHA) regulations take effect. This is often about one-half of Time Weighted Average (TWA).

B. **Formaldehyde** - a chemical with formula HCHO, used as a fixative that can cause eye and skin irritation - is a sensitizer by skin and respiratory contact. Toxic by ingestion. Target organ is the respiratory system. Suspected carcinogen, found in the laboratory as concentrated (37-40% formaldehtyde) or as 10% neutral buffered formalin (3.7-4.0% formaldehlyde).

C. **Methylene Chloride** - an organic compound with chemical formula, CH_2Cl_2. Employees exposed to Methylene Chloride are at increased risk of developing cancer, adverse effects on the heart, central nervous system and liver, and skin or eye irritation. Exposure may occur through inhalation, by absorption through the skin, or through contact with the skin. Methylene Chloride is a solvent found in the laboratory.

D. **Ethylene Oxide (EtO):** is extremely flammable, toxic by inhalation, may cause cancer, may cause inheritable genetic damage, and is an irritant to eyes, respiratory and skin.

E. **OSHA** - Occupational Safety and Health Administration (OSHA). United States (US) federal agency under the US Department of Labor created to establish and enforce standards and laws for working conditions.

F. **MIOSHA** - Michigan Occupational Safety and Health Administration (MIOSHA)

G. **ACGIH** - American Conference of Governmental Industrial Hygienists (ACGIH)

H. **PPM** - Part Per Million.

I. **Permissible Exposure Limit (PEL)** - the allowable airborne chemical exposure that an employee can be exposed to. OSHA has set several types of limits: Time Weighted Average (TWA), Short Term Exposure Limit (STEL) and Action Level (AL).

J. **Regulated Area** - areas where the concentration of airborne chemical exceeds the TWA or STEL.

K. **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.

L. **Time Weighted Average (TWA)** - the average concentration of a chemical in the air to which it is permissible to expose a worker for a period of time, usually 8 hours.

M. **Xylene** - a flammable chemical used as a non-polar solvent that is a mixture of meta, para and ortho dimethyl benzene, C_6H_{10}. Mild to moderate skin and eye irritant. Target organ effects on respiratory and central nervous system.

N. **Waste Anesthetic Gases** - are small amounts of anesthetic gases that leak from the patient's breathing mask into the air of operating or recovery rooms. These gases may also be exhaled by patients recovering from anesthesia.

O. **Emergency Spill** - a spill is classified as an emergency spill if there is greater than one liter of material spilled or if any of the following criteria are met:

1. A person is injured
2. Identity of the chemical is unknown
3. Multiple chemicals are involved
4. Chemical is highly toxic, flammable or reactive
5. Conditions that are Immediately Dangerous to Life and Health (IDLH)
6. Spill occurs in a public place such as corridors
7. Spill has the potential to spread to other parts of the building, such as through the Heating, Ventilation and Air Conditioning system (HVAC)
8. Spill may endanger the environment, such as reaching waterways or outside ground

IV. PROCEDURE:

A. Selecting

1. All hazardous gases and vapors will be managed to protect the staff, patients, and visitors from unnecessary exposures. Employee exposures will be reported to Employee Health and should be reported to Corporate Safety for investigation and compliance support. All efforts will be made to reduce the risk of exposures.
2. When selecting gases or chemicals for use in either cleaning, sterilizing, laboratory use, or administering to patients, the vapors or off-gassing of those products may and can be dangerous to the staff.
3. In order to reduce the risk to staff, the current use of aldehydes should be evaluated for safer, less toxic, and equally effective products. This process should include the department leadership, Infection Prevention, and Corporate Safety for approval and support.
4. Once the product has been reviewed and selected, the process for monitoring that product will need to be evaluated.
5. The current inventory of gases and vapors that may need to be managed and monitored located at Beaumont Health:
    a. Formaldehyde
    b. Xylene
    c. Isopropyl Alcohol

d. Ethylene Oxide
e. Methylene Chloride
f. Waste Anesthesia Gases
g. Vapors from cauterizing equipment and lasers

B. Handling and Using
    1. Levels of these hazardous vapors and gases should be maintained below action levels by appropriate containment, ventilation, and other engineering methods. Where these levels cannot be maintained:
        a. The appropriate Personal Protective Equipment (PPE) needed in the handling and usage of the chemical should be readily available to the staff. PPE can include safety eyewear/goggles, gloves, protective clothing, and respirators as primary protection against gases and vapors.
        b. The PPE should be inspected for wear and tear and should fit all the staff that work with that product.
        c. Employees must receive training on all PPE including donning and doffing, use, and limitations. See Beaumont Personal Protective Equipment - MIOSHA policy.
        d. Respiratory Protection may be required whenever the PELs are exceeded and feasible controls cannot reduce exposures below the PELs. All Respiratory Protection must meet the Beaumont Respiratory Protection Policy.
    2. Monitoring for compliance on usage of the chemical and donning of PPE should be evaluated by the Department leadership periodically.

C. Transporting and Storage
    1. Hazardous gases and vapors will be transported and stored in the appropriate container as prescribed by the manufacturer and meet regulatory requirements.

D. Disposing
    1. Disposal of these hazardous gases and/or vapors is generally exhausted to the outside air.
    2. Where the levels would exceed federal or other regulatory levels, appropriate capture or conversion systems are used to reduce the levels to acceptable levels.
    3. All documentation of waste disposal is maintained pursuant to local, state, and federal regulation and any problems or deviations will be promptly reported to the appropriate authority (when required), the department leadership, and Corporate Safety Department.

E. Monitoring
    1. Air contaminants may be measured by dosimeters, badges, or other equipment as appropriate on a periodic basis in work areas identified as using the materials/potential air contaminants. Monitoring protocols and frequencies will be established to meet regulatory requirements.
    2. Monitoring may be done:
        a. At frequencies determined by regulation or the organization
        b. To verify that conditions have not changed
        c. When a significant change in conditions, environment, equipment, or materials used indicates a retest is appropriate.
    3. Monitoring of anesthetic waste gases is completed bi-annually.
    4. Exposure Monitoring
        a. Laboratories monitor employee exposure for formaldehyde, methylene chloride, and

xylene and any other chemical that requires monitoring as required per state and federal regulation.

i. Exception: Objective documentation that employees could not be exposed to airborne chemical levels at or above STEL, TWA or Action Level, if applicable, under foreseeable conditions of use of that chemical.

b. Monitoring of other hazardous chemicals will be conducted as needed:

i. If there is a complaint of health issues possibly associated with chemicals

ii. If odor of a hazardous chemical is frequently noticed

iii. If a highly toxic chemical is being used regularly in significant quantities

iv. If for any other reason it is believed that a permissible exposure limit is routinely exceeded

5. Specific monitoring protocols and requirements will be set by the relative regulatory standards. Below is the general format that may be followed.
6. When to Monitor
    a. Initial Monitoring:
        i. Representative samples will be taken for each job description.
        ii. Each work shift shall be monitored independently unless exposure levels are documented equivalent or lower for each shift.
        iii. Initial monitoring is repeated each time there is a change in work practices or controls that would result in new or additional exposure to the chemical.
7. Employee Reporting Symptoms
    a. If an employee reports symptoms of respiratory or dermal conditions, or other conditions known to be associated with a specific chemical exposure, that individual must report issues to Employee Health and follow-up exposure monitoring may occur as appropriate.
8. Periodic Employee Monitoring
    a. To ensure no changes have occurred in ventilation, controls, work flow amounts or patterns, etc., the laboratory will monitor employees exposed to formaldehyde, methylene chloride, and/or xylene at a minimum of every three years (note: exception listed above).
    b. Above PEL: If monitoring reveals levels that are over the STEL, TWA and/or Action Level
        i. Follow procedure in "Action if over PEL Limit"
9. Emergency Spill Clean Up
    a. See Hazardous Material Spill Response Plan
    b. Evacuate the area.
    c. Isolate and contain the spill.
    d. Contact Security to assist in securing area if needed
    e. Contact the Hospital Safety Officer and/or EVS Director/Manager who will evaluate the situation. Their backup is the Director of Facilities Management or Security Manager.
    f. Knowledgeable and authorized staff should contact authorized HAZMAT emergency spill response vendor (see attached HAZMAT Emergency Response Authorized Vendors in Hazardous Material Spill Response Plan).

10. Testing is monitored by the department leadership, lab manager, or Biomedical Engineering with support from the Corporate Safety Department. Department leadership, lab manager, or Biomedical Engineering with support from the Corporate Safety Department will facilitate environmental/air monitoring activities internally or through an approved environmental consultant when needed.
11. Reports of results will be kept on file in the department and forwarded to Corporate Safety and Employee Health for review, investigation, and corrective action as needed.
    a. Testing results may also be reported to the site Environment of Care (EOC) Committee.
    b. Where testing indicates levels above the action level (or PEL for any hazardous air contaminate), immediate corrective action will be recommended for implementation by the department leadership, lab manager, and/or Corporate Safety
    c. Further monitoring to verify the effectiveness of the changes may be needed

F. Monitoring Equipment

1. Air chemical contaminants will be measured by personal monitoring badges or other equipment as appropriate and required per regulatory standards.
    a. Badges are obtained from a commercial source for the specific contaminant being measured.
    b. Badges are to be worn per the supplier's instructions
        i. This usually involves wearing the badges high on the collar, as near to the breathing zone as possible.
        ii. TWA badges are to be worn the entire day, being taken on and off various lab coats, so that the badge accompanies the employee the entire day (breaks, meals, restroom, etc.).
        iii. Badges are to be worn with the absorbing side facing out at all times.
    c. Accurate documentation of:
        i. Date of monitoring
        ii. Time opened
        iii. Time closed
        iv. Total time in use
        v. Chemical being monitored
        vi. Person's name being monitored
        vii. Activity(ies) being performed by the employee will be done
        viii. Type of Personal protective equipment (PPE) being worn
        ix. Job classification
    d. Analysis of badges will be conducted by the commercial source at an accredited laboratory.
    e. 8 Hour TWA - badge is to be placed on the employee when they arrive at work, and will remain with the employee the entire day.
        i. This includes lunch, so the TWA will remain on for 8.5 hours.
        ii. If the employee works part of the time (e.g., 4 hours), that time will be recorded.
    f. 15 minute STEL badge is to be placed on the employee when they are doing a task

that involves high levels of the chemical.

i. If the task takes longer than 15 minutes, the first badge will be taken off, and another badge will be placed on the employee for another 15 minutes.

ii. If the task does not take 15 minutes, the badge will be left on until the 15 minute period is completed.

iii. If there is more than one task that involves higher levels of a chemical, each task will be monitored separately.

g. Other Form of Monitors

i. Monitors that detect vapors in rooms are acceptable for pinning down sources of emissions, such as open containers or trash bins.

h. Environmental Consultant will be engaged for monitoring that is unable to be performed internally. Sampling plans and protocols will meet all regulatory requirements and the provisions of this policy.

G. Anesthesia Gases - Contaminant Specific Testing Procedures

1. Dosimeters, and/or an outside contractor using infrared spectrometry, or equivalent equipment will measure "Trace Anesthesia Gases" in the operating suite a minimum of two times annually (bi-annually).

a. Dosimeters are worn by the "most exposed" staff, normally the anesthesiologist, and the scrub or circulating nurse in surgical procedures. Each Operating Room (OR) is measured during several procedures over several days, at least three cases in each OR.

b. Documentation of the dosimeters, times, and dates is the responsibility of the Director of Surgical Nursing, or designee.

c. Exposures above 25 ppm Nitrous Oxide on a time weighted average over the periods measured may be reported to the EOC Committee, and the area and equipment evaluated for leakage.

d. The industrial hygiene contractor will define the testing conditions as part of the contracted services, and render a written report, including any exposures above 25ppm. Nitrous Oxide as a time weighted average. They will be expected to do spot testing for machine and system leakage as part of the testing.

e. A report of these measurements will be given to the Chief of Anesthesia and Hospital Safety Officer who will see that any necessary actions are taken for corrections.

f. A copy of the report, including necessary corrective actions, may be sent to the EOC Committee for review.

2. Testing air contaminants in the laboratory, patient service areas, or other departments. Testing will normally include Formaldehyde, Isopropyl Alcohol, Methanol, Xylene and Methylene Chloride in the laboratory. Other contaminants will be included if determined to be near permissible levels in any work location.

a. Air contaminants in the laboratory or other affected areas will be tested every three years, or as indicated by need.

b. Air testing will normally be done by passive dose dosimeters, such as charcoal cartridges, or chemical dosimeters. These are designed to be used with minimal industrial hygiene experience, and results are performed by a certified laboratory.

c. Dosimeters will be exposed as directed in the directions received with them. Accurate documentation of the times opened and closed, and total time in use is

necessary for accurate results. A blank (i.e., a cartridge opened in a neutral environment) should be processed to validate the process.

i. Accredited air monitoring badges are tested vs. a calibrated badge at the department's choice of laboratory they are sent to. If the levels are suspiciously high, an unopened badge will be sent in, from that lot number, with a notation to calibrate the other used badges against the unopened badge.

ii. This will show that there was not already chemical(s) absorption into the lot of badges. If there is some chemical already absorbed on the blank badge, the laboratory will deduct that amount of chemicals from the used badges.

iii. Notification

a. Employees participating in the monitoring will be notified within 15 days of receiving the results by being shown the monitoring report.

b. Employees will sign the results form, indicating that they have been shown the results.

c. The original signed form will be filed in the department.

d. A copy may need to be sent to Employee Health and Corporate Safety if applicable.

e. If employee is over STEL, TWA and/or Action Level, they will be notified of the plans to monitor their health and reduce their future exposure (See "Actions if Over PEL Limits").

f. Abnormal results of monitoring may be discussed at the Laboratory Safety Committee meetings and site EOC meetings.

d. Actions if over Action Level, PEL, STEL and/or TWA

i. Employees are to continue to wear Personal Protective Equipment (PPE) (nitrile gloves, water resistant gown, eye goggles, etc.) and follow chemical hygiene plan precautions (no eating in lab, etc.).

ii. Employee may be sent to Employee Health for medical surveillance per relevant regulation.

iii. Corporate Safety may be notified and other appropriate departments as needed.

iv. The tasks and working environment will be analyzed and investigated, and appropriate changes will be made to work practices and engineering controls.

v. Employees may be fit tested for appropriate respirator, which they will wear either while doing that task and/or when in the room, depending upon what task(s) is/are over the limits. All respiratory protection must meet the Beaumont Respiratory Protection Policy.

vi. A warning sign may be posted outside the regulated work area, prohibiting anyone from entering the area unless wearing the appropriate respirator and/or PPE.

vii. Sign may include: Danger, name of chemical, type of hazard, and "Authorized Personnel Only".

viii. Additional monitoring may occur until levels are below the Action Level, PEL, STEL, and/or TWA.

ix. Continued periodic monitoring can be discontinued when two (2) successive samples taken seven (7) days apart are below the Action Level/TWA and STEL.

e. Permissible Exposure Limits (PEL) (ppm/8 hours):

	Below Action level	Action level	TWA	STEL
Formaldehyde	0.5	0.5 - .075	0.75	2.0
Xylene	-	-	100	150
Methylene Chloride	-	12.5	25	125
Ethylene Oxide	-	0.5	1.0	5.0

H. Ethylene Oxide

1. See Ethylene Oxide - Royal Oak Only policy

I. Formaldehyde

1. See Formaldehyde policy

V. REFERENCES:

A. Michigan Department of Licensing and Regulatory Affairs, Occupational Health Standards, Part 301 Air contaminants for general industry. https://www.michigan.gov/leo/-/media/Project/Websites/leo/Documents/MIOSHA17/lara_miosha_part301.pdf

B. Michigan Department of Licensing and Regulatory Affairs, Occupational Health Standards, Part 304 Ethylene oxide https://www.michigan.gov/leo/-/media/Project/Websites/leo/Documents/MIOSHA5/CIS_WSH_part304.pdf?rev=5cb696e027f141248cafaef33f3785bc&hash=92040AAF7EE838F72884446F976933BE

C. Michigan Department of Licensing and Regulatory Affairs, Occupational Health Standards, Part 306 Formaldehyde. http://www.michigan.gov/documents/CIS_WSH_part306_37835_7.pdf

D. Michigan Department of Licensing and Regulatory Affairs, Occupational Health Standards, Part 313 Methyline chloride. https://www.michigan.gov/leo/-/media/Project/Websites/leo/Documents/MIOSHA5/CIS_WSH_part313.pdf?rev=a10ce3f53b874326bc0bfe868e9ad11b&hash=0DC546BEC973BE68BEE00DA42BB067DB

Approval Signatures

Step Description	Approver	Date
VP Support Services	John Fragomeni: SVP, Facilities BHSH	10/25/2022
Policy and Forms Steering Committee Approval (if needed)	Amy Blazejewski: Dir, Env & Life Safety	10/25/2022
Policy and Forms Steering Committee Approval (if needed)	Gail Juleff: Project Mgr Policy	10/25/2022
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